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THE LANTERN-FISHES OF JAPAN.

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(PLATES XI-XIV.)

As the eastern coasts of Japan are swept by the Kurosiwo, the northern branch of the equatorial current, it should be expected that the *Myctophidæ*, or Lantern-fishes, in common with other strictly pelagic organisms, would be present in large numbers. But up to the present only three species<sup>1</sup> have been reported from this region, and these based on the well-known collections made by Mr. Alan Owston of Yokohama in Sagami Bay. Further rich collections by Mr. Owston have been recently secured for the Carnegie Museum by Dr. David Starr Jordan, and the Myctophids of this collection have been very kindly placed in the hands of the writer for study. There also have been available in this connection the extensive collections of Lantern-fishes made by the U. S. Bureau of Fisheries Steamer "Albatross" in Japanese waters in 1906. An account of the latter is here included by permission of the Commissioner of Fisheries.

Thirty species are here recorded, and, as these do not include *Macrostoma japonicum* of the previous list, the total now known from the waters of Japan is thirty-one. Twelve of these belong to the genera *Dasyscopelus*, *Myctophum*, and *Centrobranchus*, and constitute a group, which are usually light in color,

<sup>1</sup> *Neoscopelus alcocki*, *Diaphus watasei*, *Macrostoma quercinum japonicum*.

with much silvery pigment on the sides, and are taken at the surface, or at least not far below. Two of these species are here described as new, so nothing is known of their distribution in other waters. But it is worthy of note that the remaining members of the surface-group are well-known forms of wide distribution, two of them having been reported from the eastern Pacific as well as from Japan, the remainder having been recorded from all three of the great oceans.

A second group comprises the genera *Diaphus* and *Lampanyctus* (including *Macrostoma*). These are deeper pelagic forms, dark in color, with steely reflections, and are taken in intermediate nets, or enter the open dredge at intermediate depths. They seem to be more restricted in their range than the species which live nearer the surface, none of the Japanese forms being known to be cosmopolitan. Of the seventeen species here recorded from this group ten are described as new and hence are of unknown distribution; four are known also from the eastern Pacific;<sup>2</sup> two are known from the western Pacific<sup>3</sup> and the Indian Ocean, and one, *Lampanyctus niger*, while reported by Brauer from the Atlantic, Pacific, and Indian Oceans, is represented in collections by very few specimens, and has not been the subject of critical study.

All the species here recorded belong to tropical seas, with the exception of *Lampanyctus nannochir* and *Lampanyctus jordani*. *L. nannochir*, which was taken by the "Albatross" in the southern Okhotsk, is peculiar to the north Pacific, extending from Bering Sea to northern Japan and to southern California; *L. jordani* has been secured on two separate occasions off the coast of Hokkaido, and is not known elsewhere. The tropical species were abundant off the southern coasts of Kiusiu and as far north as Sagami Bay. Apparently they thin out rapidly north of Tokyo, as only a few individuals were encountered off Matsushima Bay. None were found in the Sea of Japan, even in the vicinity of the Straits of Tsushima, although numerous hauls with surface and intermediate nets were made.

#### LIST OF JAPANESE SPECIES OF THE FAMILY MYCTOPHIDÆ.

*Neoscopelus macrolepidotus* Johnson.

*Dasyscopelus orientalis* sp. nov.

*spinosus* (Steindachner).

*asper* (Richardson).

<sup>2</sup> *Diaphus agassizi*, *Diaphus nanus*, *Lampanyctus townsendi*, *Lampanyctus nannochir*.

<sup>3</sup> *Diaphus caruleus*, *Lampanyctus macropterus*.

*Myctophum affine* (Lütken).*laternatum* Garman.*evermanni* Gilbert.*californiense* Eigenmann & Eigenmann.*reinhardti* (Lütken).*pterotum* (Alcock).*suborbitale* sp. nov.*valdiviæ* Brauer.*Centrobranchus chærocephalus* Fowler.*Diaphus agassizi* Gilbert.*nipponensis* sp. nov.*nanus* Gilbert.*tanakæ* sp. nov.*glandulifer* sp. nov.*anterorbitalis* sp. nov.*gigas* sp. nov.*cæruleus* (Klunziger).*latus* sp. nov.*sagamiensis* sp. nov.*Lampanyctus townsendi* Eigenmann & Eigenmann.*japonicus* (Tanaka).*nannochir* (Gilbert).*niger* (Günther).*microchir* sp. nov.*punctatissimus* sp. nov.*jordani* sp. nov.*macropterus* (Brauer).Genus *NEOSCOPELUS* Johnson.1. *Neoscopelus macrolepidotus* Johnson.

*Neoscopelus macrolepidotus* Johnson, Proc. Zool. Soc. Lond., 1863, p. 44, Pl. VII (Madeira).

*Neoscopelus alcocki* Jordan & Starks, Bull. U. S. Fish Com. for 1902 [1904], p. 580, Pl. 2, figs. 1 and 2 (Suruga Bay, Japan).

Several specimens were secured from Sagami Bay, and direct comparison of *N. alcocki* with Atlantic specimens (Albatross Station 2376, Gulf of Mexico) has

shown that the characters supposed to distinguish the Japanese species are fallacious. In Atlantic specimens also, as well as in those from Japan, the outer abdominal series of photophores ceases at about the vertical of the vent, while the second series continues along the base of the anal fin. Opposite the vent, the spots of the continuous series are very much reduced in size. They then rapidly increase opposite the anterior portion of the anal to diminish again at once, becoming very small opposite the posterior half of the anal fin. They are large again on the basal portion of the caudal peduncle, and minute on its terminal portion. These oscillations in size are exactly followed in Pacific material from Japan and the Hawaiian Islands. Atlantic specimens have also the curved series of small photophores around the vent. Careful comparison has failed to exhibit any differences.

### Genus DASYSCEPELUS Günther.

#### KEY TO JAPANESE SPECIES OF DASYSCEPELUS.

- a. Anal photophores 7 or 8 in the anterior group, 2 or 4 in the posterior, 7 + 3 the prevailing number.  
Supra-anals straight or very slightly angulated. No band of long spines along base of anal fin. **D. orientalis.**
- aa. Anal photophores 6 to 8 in the anterior group, 5 to 8 in the posterior, 7 + 6 or 7 + 7 the prevailing numbers.
  - b. Supra-anals in a straight oblique line. Adults with the scales along the base of anal developing a specialized band of long spines.....**D. spinosus.**
  - bb. Supra-anals distinctly angulated. No band of spines along base of anal.....**D. asper.**

#### 2. *Dasyscopelus orientalis* sp. nov. (Plate XI, fig. 1.)

Type 67 mm. long to base of caudal, from Misaki, Sagami Bay; Alan Owston, collector. (C. M. No. 6313.)

Closely allied to *D. pristilepis* Gilbert & Cramer, differing in the deeper body, smaller eye, more spinous scales, and in the reduction by one in the number of anal photophores. In the arrangement of the photophores, the two species wholly agree with each other, and also with *D. spinosus* and *D. opalinus*, but the species are well distinguished by the character of the scales, number of photophores, and by other details.

Measurements in hundredths of length without caudal: Length of head 28; diameter of eye 10; length of snout 5; length of longest gill-raker 5.5; interorbital width 7; length of maxillary 18; greatest depth 26; depth of caudal peduncle 9; distance from tip of snout to front of dorsal 43; to front of adipose fin 76; to base of ventrals 42; to front of anal 59; length of anal base 28; length of pectorals 26.

Dorsal rays 13; anal rays 18; ventrals with outer rudiment and 8 developed rays; pectoral rays 16. Scales of lateral line 36.

Eye large, though smaller than in *D. pristilepis*, its upper margin but little below the profile, the rounded snout protruding beyond the orbit for a distance equal to half the diameter of the eye. Teeth minute, in narrow bands on jaws, in two small round patches on head of vomer, the narrow band on palatines separated from vomer by a very short interspace. Cleft of mouth oblique; maxillary decidedly broadened at tip, extending but slightly beyond vertical from hinder margin of eye. Preopercular border nearly vertical, the checks not obliquely lengthened. Gill-rakers long and slender, the longest half the diameter of the eye, 4 + 15 in number (counted in one of the cotypes). Pectorals long and slender, usually reaching the vertical from the vent and extending to or slightly beyond the middle supra-anal photophore. Scales firm, all sharply spinous, including those of the lateral line and those on breast and belly. The spines are everywhere approximately equal, not greatly lengthened along the base of the anal fin as in *D. spinosus*. In *D. pristilepis*, the scales are thinner and less extensively spinous, the scales of the lateral line have few spines, or none, and those on breast and belly are smooth. In *D. orientalis*, the scales of the lateral line are moderately enlarged, their vertical diameter equaling their distance from the base of the dorsal fin.

*Photophores*.—A very faint pre-orbital immediately above nostril, and one better marked under the lower anterior border of the eye. Suprapectoral separated from lateral line by twice its distance from base of upper pectoral ray. Infrapectorals in line with first ventral, their interspace less than that separating the upper one from the suprapectoral. First pair of thoracics nearest the median line, the third and fourth pairs equidistant from it, the fifth pair widely divergent, inserted immediately in front of the outer ventral rays. Interval between the third and fourth pairs the shortest, that between fourth and fifth but little longer, the second interval a little shorter than the first. Supraventral vertically above the first ventral, very slightly nearer base of ventral fin than lateral line. First pair of ventrals nearly in contact, the others a little more elevated, slightly converging from the second to the fourth, which are at the sides of the vent and a little anterior to it; first ventral interval a little longer than the second, the third the shortest. Upper supra-anal immediately below but not in contact with the lateral line, on its seventeenth or eighteenth scale, in a vertical line which traverses the base of the second or third anal ray; upper and middle supra-anals in a line passing through fourth ventral, the lower



supra-anal slightly in advance of this line. Different individuals among the cotypes vary with respect to the relation of the supra-anals, some having them in a straight line, others having them very slightly angulated, as in the type. Antero-anals a little curved, the first slightly nearer base of fin. Anals 7 + 3 in the type, and this is the prevailing number in this species. The antero-anals may be seven or eight, the posterior group two, three, or four. On one side of one specimen only six antero-anals were found. One hundred and twenty-six specimens were examined, the two sides being listed separately. In these 6 + 4 occurred once, 7 + 2 in five cases, 7 + 3 in one hundred and eighty-nine cases, 7 + 4 in seventeen, 8 + 2 in sixteen, 8 + 3 in twenty-four cases. Taking the two groups separately, in the anterior 6 occurred once, 7 two hundred and eleven times, 8 occurred forty times; in the posterior group, 2 occurred twenty-one times, 3 two hundred and thirteen times, and 4 eighteen times. The total number in both groups varies from 9 to 11. One hundred and seventeen of the one hundred and twenty-six specimens were bilaterally symmetrical with regard to their photophores. The first pair of the postero-anals is above the last anal rays. Posterolateral immediately below lateral line, but not in contact with it, slightly behind vertical from last antero-anal. Precaudals two, in an oblique line, the interspace very little, if at all, greater than that between the postero-anals. No luminous areas on back, or on inferior surface of caudal peduncle, in any of the numerous adults of the collection.

Color in spirits uniform dusky brownish on upper parts and on sides of body, profusely dotted with fine black specks. Abdomen and lower side of head silvery. A lengthwise black streak on upper part of pectoral, beginning near base and widening backwards for about the basal third of the length of the fin.

This is evidently one of the most abundant species in Japanese waters. Numerous adults were obtained from Misaki, on Sagami Bay (C. M. Nos. 4614, 4615, 4616) and many immature examples were taken by the "Albatross" at the following Stations:

4921. West of Colnett Straits. Surface.

4954. Kurosiwo, east of Kagoshima. Intermediate net, 850 fathoms.

4955. Kurosiwo, east of Kagoshima. Surface.

At Station 4954, the specimens probably entered the net at or near the surface.

The type is deposited in the U. S. National Museum.

### 3. *Dasyscopelus spinosus* (Steindachner).

*Scopelus spinosus* Steindachner, Ichth. Notiz. V, 1867, p. 11, Pl. III, fig. 4 (China).

A few specimens were secured by the "Albatross" at the surface at Station 4921, south of Kagoshima ( $30^{\circ} 23' 30''$  N.,  $129^{\circ} 36' 30''$  E.). They are somewhat slenderer than Hawaiian specimens, and have the line of the supra-anals noticeably more oblique, the anterior of the series being above the interspace between third and fourth ventrals, instead of vertically above the fourth ventral as in Hawaiian material. At a Station in the South Pacific ( $16^{\circ} 39'$  S.,  $149^{\circ} 11'$  W.), the "Albatross" secured in 1899 nine specimens, of which five are of the slender type with oblique supra-anals, and four of the deeper form with steep line of supra-anals. There is no transition between the two, and although the differences are of small magnitude, they merit attention and should be noted in future collections from the Pacific.

The number of anal photophores in the five Japanese specimens ranges as follows: 6 + 6 (1), 6 + 7 (2), 7 + 5 (3), 7 + 6 (4), the two sides of each specimen being listed separately. The sum of the two groups is either 12 or 13, while in Hawaiian material it ranges from 13 to 15, with 14 prevailing (Gilbert, Bull. U. S. Fish Com. for 1903 [1905], Part 2, p. 559). This smaller number in the slender form may account for the smaller average number reported in South Sea material as compared with that from Hawaii (Gilbert, Mem. Mus. Comp. Zool., XXVI, 1908, p. 220). In the five slender specimens from the South Pacific above referred to, the anal photophores are 7 + 6 on both sides of each; in the four deep specimens from the same locality, the following numbers occur: 6 + 7 (2), 6 + 8 (1), 7 + 5 (2), 7 + 6 (2), 7 + 7 (1).

### 4. *Dasyscopelus asper* (Richardson).

*Myctophum asperum* Richardson, Voy. Erebus and Terror, 1845, p. 41, Pl. XXVII, figs. 13 to 15; habitat unknown.

In addition to the characters which have been mentioned as distinguishing this species from the nearly related *D. spinosus*, may be given the slenderer form, the decidedly wider, blunter head, the fewer gill-rakers, and the absence of the clusters of long spines, which in *D. spinosus* are attached to the scales covering the ventral series of photophores. Comparing a Japanese specimen of *D. asper*, 78 mm. long to base of caudal, with one of *D. spinosus*, 92 mm. long to base of caudal, we have the following measurements in hundredths of length as above indicated:

	<i>asper</i>	<i>spinosus</i>
Length of head.....	27	27.5
Diameter of eye.....	10	11
Width of snout at nostrils.....	8	6
Length of maxillary.....	15	17
Greatest depth of body.....	24	27
Dorsal rays.....	12	14
Anal rays.....	18	19
Pectoral rays.....	16	15
Scales in lateral line.....	39	39

In *D. asper*, the head is but little narrowed anteriorly, the upper orbital margins are nearly parallel, and the snout is high and bluntly rounded, protruding a trifle on the level of the nostrils. In *D. spinosus* the head narrows rapidly forward, the orbital margins strongly converge, the snout is not bluntly rounded and protrudes farthest at the premaxillaries.

In *D. asper*, the gill-rakers are somewhat shorter and heavier, 5 + 10 or 5 + 11 in number; in *D. spinosus* 7 + 16.

In *D. spinosus*, each scale covering a photophore of the ventral series develops long slender spines many times larger than those on neighboring scales. These are specially developed along the base of the anal fin, where the spines overlap and form a dense band. No such enlarged spines are present in *D. asper*.

Brauer finds the eye smaller than heretofore given for *D. asper*, but in adults it is but little less than two-fifths the length of the head, and is progressively smaller in the young.

*Photophores*.—The superior preorbital is usually concealed, but the inferior is conspicuous. The suprapectoral is higher than in *D. spinosus*, constantly nearer the lateral line than the base of the pectoral. From the first to the fourth, the thoracics form two evenly diverging lines, the fifth far out at the sides, opposite the outer ventral ray; the spacing of the pairs is nearly equal, the interval between third and fourth pairs shortest. Supraventral midway between lateral line and base of ventral (not nearer lateral line as in Brauer's figure). First pair of ventrals fully exposed, the two covered by a single much enlarged scale of the median series, in addition to the small special scales thus wholly overlapped; second pair somewhat farther out at the sides, forming with the third and fourth two lines gently converging backwards; the four pairs are equally spaced. Supra-anals in a very blunt angle, the anterior obliquely in front of and below the second. The upper is immediately below the lateral



line just in advance of vertical from third ventral, the second behind that from fourth ventral. The antero-anals are slightly curved, the anterior spot a little nearer the base of the anal fin. Posterolateral close under the lateral line, vertically over the last antero-anal. Only the first postero-anal over the last anal rays. In thirteen specimens, the combinations found have been as follows:

7 + 5 in 2 cases,	7 + 7 in 3 cases,
7 + 6 in 14 cases,	8 + 5 in 3 cases,
8 + 6 in 4 cases.	

The number is thus seen to agree with the range in *D. spinosus*. The pre-caudals are also similar, placed at a slight angle and a little farther apart than the spots of the anal series.

The scales develop serrations in extreme youth; well-developed spines are present in individuals 25 mm. long. As in *D. spinosus*, the luminous plates develop late. No trace of them is to be found in specimens 65 mm. long. In a male 85 mm. long, there are five overlapping luminous scales on the dorsal side of the caudal peduncle, and in a female 100 mm. long, there is a single plate below.

Specimens were obtained along the southern and eastern coasts of Japan, at the surface, from the vicinity of Nagasaki to Matsushima Bay.

#### LISTS OF STATIONS.

4909.	31° 38' 30'' N.,	129° 27' 30'' E.	Intermediate net, 300 fathoms.
4910.	31° 37' 40'' N.,	129° 26' 00'' E.	Surface.
4921.	30° 23' 30'' N.,	129° 36' 30'' E.	Surface.
4973.	33° 24' 15'' N.,	135° 30' 30'' E.	600 fathoms.
5052.	37° 57' 45'' N.,	142° 04' 00'' E.	Surface.
5081.	34° 14' 00'' N.,	138° 05' 00'' E.	Surface.

At Stations 4909 and 4973 the fish probably entered the open net near the surface.

#### Genus MYCTOPHUM Rafinesque.

##### (*Scopelus* Cuvier.)

#### KEY TO JAPANESE SPECIES OF MYCTOPHUM.

- a. No photophores above the lateral line.
  - b. Supra-anal photophores in an oblique row.
    - c. Second ventral photophore not out of line with the others. Postero-anals 5 to 7 in number.....**M. affine.**
    - cc. Second ventral photophore more elevated than the others. Postero-anals 2 or 3 in number.....**M. laternatum.**

- bb. Supra-anal photophores angulated.
- d. Second ventral photophore not elevated.
- e. A single posterolateral. Second precaudal little above the first, far below the lateral line.
- f. All postero-anals behind the anal fin; 4 to 6 in number. *M. evermanni*.
- ff. First postero-anals above the anal fin; 8 to 11 in number. *M. californiense*.
- ee. Two posterolaterals. Anterior postero-anals above the anal fin. Second precaudal widely separated from the first. . . . . *M. reinhardti*.
- dd. Second ventral elevated, vertically above the first.
- g. No suborbital photophore. First two supra-anals in line with the supra-ventral. . . . . *M. pterotum*.
- gg. A large suborbital photophore. First two supra-anals in line with the second (elevated) ventral. . . . . *M. suborbitale*.
- aa. Four photophores above the lateral line, near the dorsal profile. . . . . *M. valdiviae*.

##### 5. *Myctophum affine* (Lütken).

*Scopelus affinis* Lütken, Vidensk. Selsk. Skr., (6), 1892, p. 252, fig. 10; Atlantic and Indian Oceans.

Seventeen immature specimens were secured at the surface from Matsushima Bay and to the southward. In none of these specimens are the supra-anal photophores angulated and the precaudals obliquely placed and distant, as figured for this species by Brauer (Die Tiefsee Fische, 1906, p. 191, fig. 106), nor have these conditions been present in any of the very numerous examples examined from various parts of the Pacific. The supra-anals are in a perfectly straight line, or the middle one of the series (never the lower one) is rarely very slightly advanced.

The number of anal photophores is subject to wide variation in this form, if the entire range of the species in all oceans is taken into account; but in any one locality, or group of contiguous localities, the variation is much more restricted, and is grouped about the mode in a symmetrical manner. It is important to determine the variation curve in as large a number of individuals as possible, as a contribution to the regional variation of pelagic forms. The lantern-fishes are especially well adapted to this study, as the photophores vary regionally under conditions, which seem to leave the remainder of the organism unmodified, and serve therefore as a more delicate gauge of slight divergence than is usually available.

The number of specimens in the present collection is too small to enable us to determine finally the range of variation of the antero-anal and postero-anal photophores in Japanese waters, but seems to indicate a close correspondence

with that determined for the seas about the Hawaiian Islands (Gilbert, Deep Sea Fishes, Hawaiian Islands, 1905, p. 596; *M. margaritatum* = *M. affine*). The total number in both series ranges from 14 to 16 (in Hawaii from 13 to 17), the antero-anals ranging from 8 to 10, the postero-anals from 5 to 7. Listing separately the two sides of the 17 individuals:

Antero-anals— 8 occur in 5 cases,	Postero-anals—5 occur in 2 cases,
9 occur in 27 cases,	6 occur in 28 cases,
10 occur in 2 cases.	7 occur in 4 cases.

The following combinations occur:

8 + 6 in 3 cases,	9 + 6 in 23 cases,
8 + 7 in 2 cases,	9 + 7 in 2 cases,
9 + 5 in 2 cases,	10 + 6 in 2 cases.

Twelve of the seventeen specimens were bilaterally symmetrical, the other five varying on the two sides by one photophore in either the anterior or the posterior group.

In a small collection ranging from the latitude of the Hawaiian Islands to the equator, reported on by the writer (Mem. Mus. Comp. Zool., XXVI, 1908, p. 217), a tendency seemed apparent toward a reduction southward in the number of the photophores of the anal series. More material from this region and that south of the equator is highly desirable.

#### LIST OF STATIONS.

4921.	30° 23' 30" N.,	129° 36' 30" E.	Surface.
4927.	29° 57' 00" N.,	130° 41' 00" E.	Surface.
4978.	33° 57' 45" N.,	135° 56' 00" E.	Surface.
5052.	37° 57' 45" N.,	142° 04' 00" E.	Surface.

#### 6. *Myctophum laternatum* Garman.

*Myctophum laternatum* Garman, Mem. Mus. Comp. Zool., Vol. XXIV, 1899, p. 267, Pl. 56, fig. 1; west coast Central America, Gulf of California.

This diminutive species was recorded by Garman from the Gulf of California and the coast of Panama, and by Brauer from the west coast of Africa and from various localities in the Indian Ocean. Four specimens were taken by the "Albatross" near Nagasaki, in intermediate nets at 300 fathoms (Stations: 4909, 31° 28' 30" N., 129° 27' 30" E.; 4920, 30° 34' N., 129° 22' E.). The

largest, 20 mm. in length, has no trace of luminous plates on the caudal peduncle. The material has been directly compared with specimens from the eastern Pacific and no difference found. Young individuals of *Dasyscopelus orientalis* from the same region must be carefully distinguished. A specimen of the latter, 28 mm. long, has the scales without trace of spines. The number and distribution of the photophores are the same, but the eye in *D. orientalis* is larger, the photophores themselves are larger, there is a preorbital below the nostril more conspicuous than the one above, the lower subpectoral is decidedly below the level of the upper, the second ventral is not more elevated than the others and the precaudals are closely crowded. In *M. laternatum*, the first ventrals are closely apposed, the second far out at the sides, the third and fourth intermediate in position; the precaudals are much more widely separated than the postero-anals.

#### 7. *Myctophum californiense* Eigenmann and Eigenmann.

*Myctophum californiense* Eigenmann and Eigenmann, West. Amer. Sci., 1889, p. 124; San Diego, Cal.

A single adult male, 127 mm. long, from Station 5034, south of Nemuro, Hokkaido (43° 05' 30" N., 145° 57' 40" E.); and two adult females of the same size from Sagami Bay (C. M. No. 4607).

This species usually has been considered identical with *M. humboldti*, but examination of the type and a cotype of *californiense* from San Diego, of a third specimen from off the coast of Lower California, and the three specimens here recorded from Japan, shows agreement in a combination of minor characters which indicate specific difference from *humboldti*. These characters are as follows:

1. Pectoral rays 17 or 18 (12 to 14 in *humboldti*).
2. Entire back of caudal peduncle in adult males covered by a series of distinct luminous plates, each of which is surrounded by black pigment and separated from the adjoining plates. The series contains six large plates and may in addition contain one or two minute ones immediately behind the adipose. These are present in the type of the species and in one of the Japanese specimens. In *M. humboldti*, there are never more than one or two small inconspicuous plates on the back of the caudal peduncle. In the adult females from Japan, there are seven or eight distinct plates covering the area between the anal fin and the caudal.
3. The line of the antero-anals is nearly or entirely straight, while in

*humboldti* it is strongly arched, with the first one or two of the series nearer the base of the anal than the succeeding spots. The spots of the anal series are distinctly smaller and more crowded than the others, and more so than in *humboldti*.

4. Posterolateral slightly behind the vertical from the last antero-anal (in front of this vertical in *humboldti*).

5. Postero-anals more numerous, 8, 9, 10, and 11 in the six specimens known, three of them having 10 on each side. The range in *humboldti* cannot yet be given, as both Lütken and Brauer have unquestionably confused more than one species under that name. Both authors agree that typical examples from the Mediterranean have 8 postero-anals, which probably indicates a range of 7 to 9.

6. Middle pectoral photophore midway between the upper and the lower, or very slightly nearer the lower. In typical *humboldti*, it is considerably nearer the lower than the upper.

7. Anterior supra-anal somewhat behind vertical from second ventral (in advance of this point in *humboldti*).

Measurements of the male Japanese specimen in hundredths of the length to base of caudal (103 mm.): Length of head 25; diameter of eye 7.8; length of snout 5; length of maxillary 15.5; greatest depth of body 20; least depth 8.5; distance from tip of snout to front of dorsal 44; to adipose 76; to base of ventrals 40; to front of anal 58; from last anal ray to middle of caudal base 19; length of base of dorsal 15.5; of anal 25.

Dorsal rays 15; anal rays 22; pectoral rays 17; ventral rays 9, the outer ray a short rudiment. Scales of lateral line 42. Gill-rakers very long and slender, 6 + 19.

*Photophores*.—Three pectorals equally spaced, the upper equidistant from the upper pectoral ray and from the nearest point on the lateral line. First three pairs of thoracics forming regularly diverging lines, the fourth pair again lower, the fifth much divergent, at base of outer ventral rays. Supraventral halfway between the lateral line and the base of ventrals, distinctly above the horizontal line joining the first two supra-anals. First pair of ventrals partially concealed by the inner ventral rays, their interspace equal to that of the fourth pair, less than that of second and third pairs (first pair less separated in other specimens); distance between first and second and between third and fourth ventrals equal, that between second and third less. Anterior supra-anal on a level with the second, slightly behind the vertical from the second ventral;



second supra-anal above (or slightly in advance of) the fourth ventral, nearer the fourth ventral than the upper supra-anal, which is above the anus and scarcely in contact with the lateral line. Anals 7 + 10, small, close-set, in a straight line, the anterior not lower than the others; the last antero-anal is above the thirteenth anal ray, the fifth postero-anal over the last anal ray. Posterolateral somewhat behind the vertical from the last antero-anal, immediately below the lateral line. Precaudals obliquely placed, the second higher and separated from the first by a wider interval than that between the anal photophores.

The six large luminous plates on back of caudal peduncle are very conspicuous, as they are lustrous white on a black background. The scales are lost and the integument partly gone, but the general color seems to have been dusky, blackish at the base of the fins.

*Myctophum boöps* Richardson is probably a synonym of *M. humboldti*. The figure of the type gives thirteen rays in the pectoral fin, the description fifteen, both numbers within the known range of *humboldti*.

#### 8. *Myctophum evermanni* Gilbert.

*Myctophum evermanni* Gilbert, Bull. U. S. Fish Com. for 1903 [1905], p. 597, Pl. 70, fig. 1; Hawaii.

Several young specimens agreeing wholly with types from the Hawaiian Islands were taken in the Eastern Sea off southern Japan. Listing separately the fifteen specimens of the collection, we have the following combinations of anal photophores:

7 + 5 (2); 7 + 6 (4); 8 + 4 (1); 8 + 5 (10); 8 + 6 (9); 9 + 5 (2); 9 + 6 (2).

Taken at Station 4921, 30° 23' 30'' N., 129° 36' 30'' E., at the surface.

#### 9. *Myctophum reinhardtii* (Lütken).

*Scopelus reinhardtii* Lütken, Vidensk. Selsk. Skr., (6), 1892, p. 257, fig. 16; Atlantic.

Three young specimens agreeing wholly with Hawaiian material heretofore described (*Myctophum braueri* Gilbert, Bull. U. S. Fish Comm. for 1903 [1905], p. 598, Pl. 70, fig. 1).

Anal photophores 6 + 8 (3), or 7 + 7 (3).

#### LIST OF STATIONS.

- |       |             |             |          |
|-------|-------------|-------------|----------|
| 4927. | 29° 57' N., | 130° 41' E. | Surface. |
| 4954. | 32° 05' N., | 133° 02' E. | Surface. |
| 4955. | 32° 32' N., | 132° 39' E. | Surface. |

10. *Myctophum pterotum* (Alcock).

*Scopelus* (*Myctophum*) *pterotus* Alcock, Ann. Mag. Nat. Hist., 1890, p. 217; Indian Ocean.

*Myctophum gilberti*, Evermann and Scale, Bull. U. S. Bur. Fish., 1907, p. 55; Philippine Islands.

Sixty-five specimens were collected by Professor J. O. Snyder in the market at Kagoshima (C. M. No. 4600), and have been examined with reference to the excessive variation which Brauer has reported in this species. No indication of such variation is given in the Japanese material, nor in numerous specimens from the Eastern Pacific, with which we have compared it. On the contrary, both as regards number and position of the photophores, this seems to be a very constant type. Brauer's results were partly based on his failure to distinguish between *M. pterotum* and *M. fibulatum* Gilbert and Cramer, the latter from the Hawaiian Islands. The two species are perfectly distinct and can be recognized at a glance at any age after the photophores have developed. Brauer's text-figure 93 (Die Tiefsee Fische, 1906, p. 182) represents *M. fibulatum* and not *M. pterotum*, and may have been drawn from one of the specimens which Brauer examined from the Hawaiian Islands. Much is lost in this volume through the failure to specify the locality of specimens from which the drawings were made, and in general to discuss what are conceived to be variations of the different forms in relation to their geographic distribution.

*M. pterotum* is a diminutive species, the majority of mature specimens ranging from 50 to 60 mm. in total length, none yet reported in excess of 70 mm. Mature females of 50 mm. are in the Japanese material. In neither males nor females are there well-developed luminous plates on the caudal peduncle, such as figured by Brauer (*l. c.*, text-figure 94), but occasionally a very faint single luminous scale can be detected on the back of the caudal peduncle in both sexes. No luminous scales on the under surface of the caudal peduncle are present in any specimens.

In the arrangement of the photophores, *M. pterotum* differs constantly from *M. fibulatum* in the following respects: 1. The first and second supra-anals, the supraventral and the suprapectoral are in a straight line which passes obliquely forwards and upwards from the second supra-anal. In *M. fibulatum*, the line of the two lower supra-anals passes forwards and downwards, traversing the second (elevated) ventral, and leaving both supraventral and suprapectoral far above it.

2. Supraventral lower, its distance from lateral line half its distance from base of ventrals (one-third its distance from base of ventrals in *M. fibulatum*).

3. Suprapectoral lower, equidistant from pectoral base and lateral line (distance from lateral line half its distance from pectoral base in *M. fibulatum*).

4. Upper preopercular spot on level of middle of eye (on level of lower margin of eye in *M. fibulatum*).

5. Upper supra-anal and the posterolateral separated from lateral line by a space equal to their own diameter (almost touching the lateral line in *M. fibulatum*). In both species, the upper precaudal fails to touch the lateral line.

6. The elevated second ventral is over the middle of the interspace between the first and third ventral (almost vertically above the first ventral in *M. fibulatum*).

In addition to these characters, the eye in *M. pterotum* is much smaller and has constantly a round peculiarly contracted pupil, while in *M. fibulatum*, the eye is larger and the pupil is large and ovate in shape, the major axis passing from above downwards and backwards, and the upper portion of the iris is darkly pigmented while the lower half is silvery. In *M. pterotum*, the opercle terminates in a long tongue-shaped process, which covers the suprapectoral photophore and extends above the pectoral fin and beyond its base. This process is not present in *M. fibulatum*. The latter is a larger species, reaching a length of at least 100 mm. The mature female develops a single luminous scale on the back of the caudal peduncle, the male may develop two.

In Japanese specimens of *M. pterotum*, the prevailing number of anal photophores is 6 + 4, this number occurring on both sides of fifty-six of the sixty-five individuals, and on one side of four others. Total combinations are 5 + 4 (2), 5 + 5 (7), 6 + 3 (2), 6 + 4 (116), and 6 + 5 (3).

The antero-anals are always in a curved line, the first much nearer the anal base than the others, the first and second more widely spaced than the following.

#### 11. *Myctophum suborbitale* sp. nov.

Type 17 mm. long to base of caudal fin, from Station 5064, in Suruga Bay; taken in open intermediate net down to 300 fathoms.

Closely allied to *M. pterotum* and *M. fibulatum*, but differing from these and all other species of the genus in the presence of a small round photophore on the cheek below the posterior portion of the eye.

Measurements in hundredths of length without the caudal fin: Length of head 35; diameter of eye 13; length of snout 5.5; length of maxillary 23; depth of body 25; of caudal peduncle 8; predorsal length 55; length of dorsal base 18; pre-anal length 60; length of anal base 28; length of pectoral fin 32.

Dorsal rays 12; anal rays 17; pectoral rays 11 or 12; ventral rays 8. Scales of lateral line 34.

Snout short, not bluntly rounded; mouth very oblique, the maxillary broadened posteriorly, extending well behind eye and nearly to the preopercular margin, which is not oblique. Eye large, more than one-third the length of the head. Opercle posteriorly extended, wholly covering the upper and lower pectoral photophores, notched opposite the pectoral base. Pectoral fin long, extending beyond the origin of the anal. Anal much longer than the dorsal, its origin under the middle of the dorsal base, its last ray under the adipose fin. Ventrals reaching the anus. Scales all fallen, the scars indicating that those along the lateral line were not at all enlarged.

*Photophores*.—A minute pre-orbital, on the dorsal side of the nostril. A well-developed subocular spot, not present in any other species of this genus, on cheek below the hinder part of the eye, near the maxillary border. Lower pre-opercular spot very small, opposite the expanded end of the maxillary, the upper large, placed entirely below the level of the eye, differing in this respect strikingly from its position in *M. pterotum*. Suprapectoral vertically above the lower infrapectoral and the second thoracic, situated obliquely above and anterior to the pectoral base, slightly nearer to the pectoral than the lateral line. Lower infrapectoral anterior to the upper and but little below it. Thoracics 5, the anterior two interspaces wider than the posterior two; the first pair nearest the median line, the fifth pair more widely separated, at base of outer ventral rays. Supraventral vertically over the fifth thoracic, or even slightly anterior to this line, its distance from lateral line about one-fourth its distance from base of ventrals. Ventrals four, the second elevated, vertically above the first, on a level with the second infrapectoral; the other three contiguous to the midventral line, the space between the first and third longer than that between third and fourth. Supra-anals 3, sharply angulated, the third on the lateral line, vertically above the first antero-anal, the second half-way between lateral line and base of first anal ray, the third horizontally in front of the second, very slightly above a line joining the second with the elevated ventral. In the distribution of the photophores, this species agrees with *M. fibulatum*, having the second ventral and the first two supra-anals in line, the supraventral far above them. In *M. pterotum*, the first two supra-anals and the supraventral are in line. Antero-anals 6, equidistant from the base of fin. Posterolateral single, on the lateral line, vertically above the second or third anal ray before the last. Postero-anals 5, the first above the base of the



last anal ray. Precaudals widely separated, the first at base of rudimentary caudal rays, the second obliquely above and behind it, on the lateral line. In the largest specimen, 30 mm. long (too badly mutilated to serve as the type), are two luminous spots on the under side of the caudal peduncle. In the type and numerous other smaller specimens, none are developed. Their presence in a specimen 30 mm. long (doubtless a female), indicates that it approaches maturity and that the species is a diminutive one.

General color dusky, as in related species, with little luster.

#### LIST OF STATIONS.

4909.	31° 38' 30'' N.,	129° 27' 30'' E.	Intermediate net, 300 fathoms.
4920.	30° 34' N.,	129° 22' E.	Intermediate net, 300 fathoms.
5064.	35° 02' 10'' N.,	138° 38' E.	Intermediate net, 300 fathoms.
5084.	34° 00' 00'' N.,	137° 49' 40'' E.	Intermediate net, 918 fathoms.

These localities are along the southern coast, from the vicinity of Kagoshima to Suruga Gulf. It was also secured by Mr. Owston in Sagami Bay. The type is deposited in the U. S. National Museum.

#### 12. *Myctophum valdiviæ* Brauer.

*Myctophum valdiviæ* Brauer, Zool. Anz., Vol. 28, 1904, p. 398, fig. 6. Atlantic and Indian Oceans.

A single badly injured specimen has the upper series of photophores arranged along the dorsal outline, a position unknown in any other species, and is hence identified with *M. valdiviæ*. It was taken at Station 4920, south of Kagoshima (30° 34' N., 129° 22' E.), in the open intermediate net down to 300 fathoms.

#### Genus *CENTROBRANCHUS* Fowler.

#### 13. *Centrobranchus chærocephalus* Fowler.

*Centrobranchus chærocephalus* Fowler, Proc. Acad. Nat. Sci. Phila., Vol. 55, 1903 [1904], p. 754; Hawaiian Islands.

A single young specimen from Station 4921, south of Kagoshima (30° 23' 30'' N., 129° 36' 30'' E.). As usual in this species, the supra-anals are very obliquely arranged, the anterior of the series over the interspace between the second and third ventrals. There are 5 antero-anals and 9 postero-anals, a combination which did not occur in seventy-one specimens reported on previously from the Hawaiian Islands; but both numbers occurred there separately.



## Genus DIAPHUS Eigenmann &amp; Eigenmann.

## KEY TO JAPANESE SPECIES OF DIAPHUS.

- a. Pre-orbital photophore confined to a single minute dot above the nostril.
  - b. Upper supra-anal and the posterolateral immediately below the lateral line. . . . . *D. agassizi*.
  - bb. Upper supra-anal and the posterolateral far below the lateral line. . . . . *D. nipponensis*.
- aa. Upper pre-orbitals on the front of the snout, directed forwards like headlights, occupying each a roundish depression above the nostril.
  - c. Accessory gland developed in connection with suprapectoral only.
    - d. Lower pre-orbital widely separated from the upper on lower anterior border of orbit, a minute detached subocular point usually present behind it. Pre-opercular border nearly vertical. . . . . *D. nanus*.
    - dd. No lower detached pre-orbital, the upper continuous with a narrow strand along anterior border of orbit. Pre-opercular border oblique.
      - e. Third ventral elevated, in line with supraventral, second supra-anal and first antero-anal. Third precaudal midway between first and fourth, the last interspace much the widest. . . . . *D. tanakæ*.
      - ee. Third ventral low, much below the line joining supraventral and second supra-anal. Last precaudal interspace little wider than the others.
        - D. sagamiensis*.
  - cc. Accessory glands developed in connection with all the photophores of the upper lateral series. No lower pre-orbital, a large suborbital. . . . . *D. glandulifer*.
  - aaa. A narrow luminous bar on upper and one on lower orbital border, the latter continued as a very narrow strand around front of orbit. . . . . *D. anteorbitalis*.
  - aaaa. Pre-orbital expanded to cover the entire snout. . . . . *D. gigas*.
  - aaaaa. Pre-orbital not as above, narrow, occupying the anterior or anterior and inferior border of the orbit, without detached portion (the upper portion expanded above nostrils in *D. sagamiensis*).
    - f. Upper series of photophores well below the lateral line. . . . . *D. cœruleus*.
    - ff. Upper series of photophores immediately below the lateral line.
      - g. Pre-orbital not continued along lower margin of orbit. First antero-anal greatly elevated, nearly vertically above the second. . . . . *D. latus*.
      - gg. Pre-orbital continuous with a luminous strand which extends along the most of the inferior border of the orbit. First antero-anal not greatly elevated, above and anterior to the second. . . . . *D. sagamiensis*.

14. *Diaphus agassizi* Gilbert.

*Diaphus agassizii* Gilbert, Mem. Mus. Comp. Zool., XXVI, 1908, p. 226, Pl. 2 (Marquesas Islands).

Several specimens, the largest 26 mm. long, from Suruga Bay, in open intermediate net at 300 fathoms.

In the figure of the type above cited, the suprapectoral should be higher, a little above the level of the supraventral, and somewhat nearer lateral line than base of pectoral. Also, the third ventral should be higher on side, on a

level with the second supra-anal, or a trifle above its level, and the third ventral, the second supra-anal, and the first antero-anal in a nearly straight horizontal line.

The anal photophores are 6 to 7 + 5 to 6 in the Japanese material, 6 + 6 and 7 + 5 being the prevailing combinations, 6 + 5 and 7 + 6 also occurring. The number 8 was not found in the anterior group, though this occurred in the type specimen. There are no traces of luminous areas around the eye, but the minute pre-orbital photophore above the nostril is present in all specimens. In this respect, the species agrees with *D. nocturnus* Poey (= *lacerta* Goode and Bean), but has no trace of the minute inferior photophore present in the latter within the lower anterior rim of the orbit (Gilbert, Bull. Mus. Comp. Zool., XLVI, 1906, p. 257, Pl. 1).

#### LIST OF STATIONS.

4969.	33° 23' 40'' N., 135° 33' 00'' E.	587 fathoms.
5058.	Suruga Bay.	Intermediate net, 300 fathoms.
5063.	Suruga Bay.	Intermediate net, 300 fathoms.
5064.	Suruga Bay.	Intermediate net, 300 fathoms.

#### 15. *Diaphus nipponensis* sp. nov.

Type 21 mm. long, from Albatross Station 4920, south of Kagoshima (30° 34' N., 129° 22' E.), open intermediate net at 300 fathoms.

Very closely allied to *D. gemellari* (Cocco), differing in the lower position of the photophores of the upper series, the straight supra-anals (not angulated), and the position of the last antero-anal and first postero-anal, neither of which is elevated. In certain of these respects the species agrees with Brauer's figure of a specimen from Messina (Die Tiefsee Fische, 1908, p. 213, text-figure 131), but the latter differs in so many respects from typical *D. gemellari*, including contour of head, size of the dorsal fin, the position of the postero-lateral with reference to the adjacent spots of the anal series, and the position of the precaudals, that we are justified in doubting the identity of this specimen with *D. gemellari*.

Measurements in hundredths of length exclusive of caudal fin (16 mm.): Length of head 35; axial length of snout 6; diameter of eye 7; length of maxillary 27; greatest depth 28; least depth of caudal peduncle 13; distance from tip of snout to front of dorsal 47; to insertion of ventrals 46; to front of anal 63.

Dorsal rays 16; anal rays 14; pectoral rays 11 or 12; ventral rays 9. Scales of lateral line 36.

The shape of the head resembles that of *D. agassizi*, having a long snout protruding beyond the orbit for a distance nearly equaling the diameter of the latter and a long maxillary accompanied by an oblique pre-opercular margin. The eye is very small and everywhere far from the profile.

The origin of the dorsal is somewhat in advance of the middle of the length (without caudal); posteriorly it overlaps the front of the anal. The adipose fin is inserted over the last anal rays.

*Photophores*.—A minute round pre-orbital on orbital rim above the level of the nostril as in *gemellari* and *agassizi*. Suprapectoral very low, above and in front of the pectoral, distant from it not farther than the width of the pectoral base, less than one-third its distance from lateral line. Upper infrapectoral in front of lower pectoral rays, not in contact with their base; lower infrapectoral slightly below the line joining the upper with the first thoracic, and a little nearer the upper. Fourth thoracic over middle of interspace between third and fifth, barely above the level of the base of the ventral fin; second thoracic midway between first and fifth, the second interspace the shortest; fifth thoracic not so far out as usual, in front of middle of ventral base. Supraventral over axil of ventrals, its distance from base of fin, half its distance from lateral line. Third ventrals barely above base of outer ventral ray, on a level with fourth thoracic and first supra-anal; fifth ventrals at sides of vent. Supra-anals in a very oblique straight line, which includes also the fifth ventral, the four spots equally spaced; third supra-anal but little in advance of the first anal, equidistant between it and the lateral line. Antero-anals 5, equally spaced, in a straight line, none of them elevated. Posterolateral single, directly over the interspace between the two anal series, resembling an elevated antero-anal and scarcely more distant from the last of that series than the antero-anals are from one another. Postero-anals 6, in a straight line, the anterior very slightly elevated on one side, not on the other. Anterior precaudals lying lower than the anal series, the four forming a very gentle nearly horizontal curve and all equally spaced; the fourth is twice as far from the lateral line as from the lower margin of the caudal fin.

Light brownish, the margins of the scales coarsely pigmented with darker, the sides of head and snout lighter.

Only the type known; deposited in the U. S. National Museum.

#### 16. *Diaphus nanus* Gilbert.

*Diaphus nanus* Gilbert, Mem. Mus. Comp. Zool., XXVI, 1908, p. 224, Pl. 1.  
(Marquesas Islands.)

Several specimens off the southern coasts of Kiusiu and Hondo, taken in the intermediate nets operated at 300 fathoms and below. The largest individual is 45 mm. long, but answers well to the description and figure of the type, though this was very immature (17 mm. long). The photophores and the pre-orbital luminous organs do not vary in size or position with growth. The first antero-anal is not equally elevated with the second supra-anal as shown in the figure, but is constantly below the level of the latter. The lower pre-orbital varies extensively in different specimens, as in the closely related *D. theta*, being sometimes reduced to a small spot below the anterior margin of the pupil and sometimes developed so as to fill in the entire space between the eye, the front of the premaxillaries, and the nostril. A suborbital dot is usually present below the middle of the pupil. The anal photophores are usually  $5 + 4$  or  $5 + 5$  in number, occasionally  $6 + 4$  or  $6 + 5$ , 3 in the posterior group on one side only in one specimen. In a few individuals, including several very immature and one of larger size, the first antero-anal is not elevated, but lies close to the base of the anterior anal rays. In all other respects, including the angulated supra-anals and the high position of the upper row of photophores, these agree with the other specimens, so we are clearly concerned with a question of individual variation.

## LIST OF STATIONS.

4920.	30° 34' N.,	129° 22' E	Intermediate net, 300 fathoms.
4951.	31° 10' 30'' N.,	131° 58' 30'' E.	Intermediate net, 300 fathoms.
4954.	32° 05' N.,	133° 02' E.	Intermediate net, 300 fathoms.
5063.	35° 01' 10'' N.,	138° 38' 50'' E.	Intermediate net, 300 fathoms.

17. *Diaphus tanakæ* sp. nov.

Type 21 mm. long, from Albatross Station 4951, off the southern coast of Kiusiu (31° 10' 30'' N., 131° 58' 30'' E.), intermediate net at 300 fathoms.

Very closely related to *D. nanus* Gilbert, but with the upper series of photophores somewhat higher, the third supra-anal vertically above the second or slightly in advance of it (well behind it in *D. nanus*), the posterolateral vertically above the last antero-anal (behind it in *D. nanus*), and the last pre-caudal interspace decidedly wider than those which precede (but little wider in *D. nanus*). The eye is smaller, the snout longer, the maxillary much longer, the pre-orbital luminous bodies are different in shape and in extent.

Measurements in hundredths of length without caudal (16 mm.): Length



of head 37; greatest depth 27; least depth of caudal peduncle 14; axial length of snout 5; diameter of eye 9; length of maxillary 24; distance from tip of snout to origin of dorsal 47; to insertion of ventrals 49; to front of anal 64.

Dorsal rays 15; anal rays 15; pectoral rays 11 or 12. Scales of lateral line 36.

Snout bluntly rounded, but protruding beyond the eye farther than in *D. nanus* and related species, its axial length somewhat greater than half the diameter of the eye. Maxillary long, extending beyond the orbit a distance equaling seven-ninths the diameter of the orbit, its posterior portion not widened; pre-opercular border oblique.

Pectorals reaching base of ventrals, the latter slightly overlapping front of anal. Insertion of ventrals behind the vertical of origin of dorsal; anal not overlapping the dorsal.

*Photophores*.—Pre-orbitals small roundish bodies immediately above the nostrils, directed forwards and little visible from the side; they are about as large as the nostrils and are widely separated mesially; from their lower outer border a very narrow luminous streak extends downwards around the anterior border of the eye, but not on its ventral aspect. The posterior outer border, both of the slender streak and of the rounded expansion above the nostril, is densely pigmented. No line of division can be detected between the two portions. No sub-ocular spot. Suprapectoral midway between lateral line and base of pectoral. Fourth thoracic above and a trifle behind the third, on the level of the middle of pectoral base. Second thoracics midway between first and fifth, the second and fourth interspaces nearly equal. Supraventrals slightly nearer base of ventrals than lateral line. Third ventral lower than supraventral, on a level with the second supra-anal. Upper supra-anal in contact with the lateral line, or a mere trifle below it, vertically above the second, which is above and a little behind the first; the first and second are very close, the space between them less than half that separating the second and third, and the first is still nearer the fifth ventral, which is before and a little below it. First antero-anal elevated, nearly as high as the second supra-anal, in an oblique line joining second antero-anal and upper supra-anal. Antero-anals 6, the second to the fifth in a straight line diverging from base of anal a little posteriorly, the sixth elevated, obliquely above and behind the fifth, the last interspace equal to those that precede. Posterolateral vertically above the sixth antero-anal, in contact with the lateral line. Postero-anals 5, all on the same level. Precaudals 4, the first three equally spaced, in a gentle curve following base of lower caudal lobe, the fourth more elevated, above and behind the third, very near the lateral line, the third equidistant from the first and the fourth.



Color dark brown, apparently deeper at base of caudal; cheeks, mandible and snout whitish in spirits, probably translucent in life.

Two small cotypes from the same station as the type and one from Station 4977, 33° 23' N., 135° 37' 40" E., 544 fathoms, but probably taken nearer the surface. Type deposited in the U. S. National Museum.

Named for Shigeho Tanaka of the Imperial University at Tokyo, for his valuable contributions to the ichthyology of Japan.

18. *Diaphus glandulifer* sp. nov. (Plate XI, fig. 2.)

Type 58 mm. long without the caudal fin, from Station 5058, Suruga Gulf, taken with an intermediate net hauled at 300 fathoms.

Differing from all known species of the genus in the extensive development of the glandular organs of the photophores. In other species, only one is present, attached to the suprapectoral, while in the present species, glands are attached to all the photophores of the upper series and to the majority which are intermediate in position between the upper and the ventral series. A round pre-orbital above the nostril, directed forward, and a conspicuous suborbital under middle of eye. No inferior pre-orbital.

Measurements in hundredths of length to base of caudal: Length of head 32; diameter of eye 8; width over middle of orbits 9.5; length of snout 4; length of maxillary 23; oblique length of cheek 13; depth of body 21; depth of caudal peduncle 9; predorsal length 45; base of dorsal 19; preanal length 63; base of anal 18; length of pectorals 15; length of ventrals 23.

Dorsal rays 15 (including rudiments, the last ray cleft to base); anal rays 15 (last ray cleft to base); pectoral rays 12 or 13; ventral rays 8. Scales of lateral line 34.

Snout short, bluntly and evenly rounded; pre-opercular margin oblique, the maxillary scarcely widened posteriorly, almost reaching pre-opercular margin, twice as long as snout and orbit. Gill-rakers 10 + 19, the longest six hundredths of the total length without caudal. Origin of dorsal over base of ventrals, its last ray above the vent. Adipose fin over last anal ray. Pectorals short, barely attaining the base of the ventrals, which pass the origin of the anal.

*Photophores*.—A roundish pre-orbital in a pit of the dorsal side of the nostril, extending mesad nearly to the median crest; lower pre-orbital wanting. Sub-orbital very sharply defined, invariable in shape and position; it is large, roundish in outline, encroaches on lower part of eyeball, and lies in or slightly behind its vertical diameter. It evidently corresponds to the detached point

from the inferior preorbital in *D. rafinesquei*, *theta*, and *nanus*, and is developed in specimens 12 mm. long. The anterior and inferior orbital margins densely black. Suprapectoral low, midway between upper pectoral ray and lateral line. First pair of thoracics nearest the median line, second and third pairs equidistant from it, fifth pair separated by more than twice the distance separating the third pair; fourth thoracic elevated but little above the ventral base, a little behind the vertical from the third thoracic. Supraventral high, its distance from lateral line two-fifths the distance from base of ventrals. Second and third ventrals unusually high, the third on middle of area below lateral line, a little below the line joining the first and second, and slightly in advance of the vertical from the fourth. First supra-anal at the side of the vent, in line with the first, fourth and fifth ventrals and apparently forming one of the ventral series. Line of the supra-anals slightly angulated, the second in advance of the line joining first and third. Third supra-anal not in contact with the lateral line, but under the lower part of its 18th scale. Antero-anals 6, the first and last elevated, the others in a straight line parallel to anal base, the first about on level of middle supra-anal, in a line joining upper supra-anal and second antero-anal; the last slightly behind the line joining the fifth antero-anal and the posterolateral, equidistant from both. Posterolateral immediately below the lateral line. Postero-anals 5. Precaudals 4, the first two placed horizontally and lying deeper than the postero-anals, the third a little elevated and more widely spaced, the fourth much more widely spaced, near the lateral line, and but little behind the third.

Glandular bodies are always connected with the suprapectoral, supra-anal, the posterolateral, and the upper precaudal; usually also with both infra-pectorals, the fourth thoracic and the second and third ventrals; occasionally with the first antero-anal and the third precaudal.

General color blackish, with metallic bluish reflections.

A number of cotypes from the following Stations, and also from Sagami Bay (C. M. No. 4606). The type is deposited in the U. S. National Museum.

#### LIST OF STATIONS.

4926.	Colnett Strait, south of Kagoshima	Intermediate net, 300 fathoms.
5058.	Suruga Bay.	Intermediate net, 300 fathoms.
5063.	Suruga Bay.	Intermediate net, 300 fathoms.
5064.	Suruga Bay.	Intermediate net, 300 fathoms.
5084.	Suruga Bay.	Intermediate net, 300 fathoms.

19. *Diaphus anteorbitalis* sp. nov. (Plate XII, fig. 1.)

Type 93 mm. long to base of caudal, from Station 4968, off Shiwo Misako (33° 24' 50" N., 135° 38' 40" E.), depth 253 fathoms.

Very closely allied to *D. adenomus* Gilbert from the Hawaiian Islands, differing only in the greater development of the circumocular luminous bodies, in the slightly higher position of the suprapectoral photophore, and in the larger eye.

Measurements in hundredths of total length to base of caudal: Length of head 28.5; diameter of eye 7.5; interorbital width above middle of eye 9; length of snout 5; of maxillary 22; greatest depth of body 22; least depth of caudal peduncle 11; distance from tip of snout to front of dorsal 43; to base of outer ventral ray 43; to base of last dorsal ray 60; to front of anal 64; to last anal ray 81; to adipose fin 80; length of base of anal fin 18; of dorsal fin 19.

Dorsal rays 15 (3 rudiments; last ray cleft to base); anal rays 15 (2 rudiments); pectoral rays 12; ventral rays 9, the outer ray short, rudimentary. Scales of lateral line 36, the third supra-anal photophore on the 18th scale, the posterolateral on the 25th. Gill-rakers 5 + 11.

Diameter of eye about one-fourth length of head (about one-fifth head in *D. adenomus*). Origin of dorsal and base of outer ventral ray in the same vertical; last dorsal ray over the vent; last anal ray under the adipose fin. Pectoral reaching a point halfway between fourth thoracic photophore and base of ventral. Longest ventral ray reaching to or nearly to the vent.

A well-developed supra-orbital luminous body, as in *D. adenomus*, found only in these two species. It is in the form of a narrow streak along the upper border of the orbit, not extending behind the pupil; a small superior pre-orbital, in its usual position above the nostril; a third luminous body occupies the position of both suborbital and inferior pre-orbital, extending on the inferior border of the eye to or beyond the middle of the orbit, becoming abruptly narrowed beneath front of eye and sending a narrow upward extension nearly to the level of the superior pre-orbital. In *D. adenomus*, both the superior pre-orbital and the extension between eye and nostril are lacking. Suprapectoral photophore above the angle of the opercular flap, slightly nearer base of pectoral than lateral line, accompanied below by a small glandular body. Fourth thoracic and third ventral low, but little above the level of the ventral base. Supraventral midway between the lateral line and the ventral base, or a trifle nearer the lateral line. Supra-anals in a nearly straight line, the middle spot slightly behind the line which joins the other two and passes just caudad

of the fifth ventral. Upper supra-anal immediately below the lateral line, the posterolateral and the upper precaudal slightly below its level. Antero-anals about equally spaced, the first above and anterior to the second, less elevated than the middle supra-anal. Last antero-anal elevated, nearly midway between its predecessor and the posterolateral, but a trifle behind the line joining the two. The remaining four posteroanals form a gently curved line which rises slightly posteriorly. Postero-anals five (six in one cotype). Precaudals forming a gently curved line nearly parallel with base of lower caudal lobe, the upper spots more widely spaced than the lower two.

General color dusky; lining of mouth and gill cavity black, the opercle with blue-black reflections. A black area above each eye. A dusky band across the mandible below eye. Fins with minute dark specks.

Three cotypes from the same locality as the type; the latter is deposited in the U. S. National Museum.

20. *Diaphus gigas* sp. nov. (Plate XII, fig. 2.)

Type 172 mm. in total length, 140 mm. to base of caudal, from Sagami Bay; collection of Alan Owston (C. M. No. 4601).

Most nearly related to *D. chrysorhynchus* Gilbert and Cramer and *D. perspicillatus* Ogilby. From both species it differs in the greater development of the inferior pre-orbital, which is produced dorsally well beyond the small triangular superior pre-orbital. It differs further from *D. perspicillatus* in the lower position of the third ventral photophore, and from *D. chrysorhynchus* in the lower suprapectoral and in the restriction of the inferior pre-orbital to the portion of the lower orbital rim in advance of the pupil. In *D. chrysorhynchus*, it extends to below the posterior margin of the pupil.

Brauer's description and figure of *D. elucens* (Die Tiefsee Fische, pp. 219, 220), fails to indicate any difference from *D. perspicillatus*, with which it is probably identical.

Measurements in hundredths of length without caudal: Length of head 29; diameter of eye 8.5; length of snout 3.8; frontal width at middle of eyes 10; length of maxillary 19.5; distance from eye to end of maxillary 11; depth of body 20; of caudal peduncle 8.5; distance from tip of snout to front of dorsal 42; to base of ventrals 43.5; to last dorsal ray 62.5; to front of anal 63.5; to last anal ray 81; to adipose dorsal 80. Length of pectorals 13; of ventrals 18.

Dorsal rays 15 (2 rudiments); anal rays 15 (2 rudiments); ventral rays 9 (1 rudiment); pectoral rays 11. Scales of lateral line 35, the upper supra-anal on the 18th scale, the posterolateral on the 25th. Gill-rakers long, 8 + 16.



As in related species, the eye is large, the snout very short and high, bluntly rounded. Preopercular margin only moderately oblique, the maxillary reaching its anterior border. Pectoral not quite reaching base of ventrals, the latter attaining the vent. Dorsal beginning slightly in advance of base of ventrals, the anal a little behind last dorsal ray, the adipose fin above the last anal ray. Scales of lateral line not enlarged, their vertical diameter nowhere exceeding their distance from middorsal line.

*Photophores*.—Superior pre-orbital smaller than in *D. chrysorhynchus*, oval in shape, the massive inferior pre-orbital expanding above the nostril, occupying all the area between the smaller pre-orbital and the median crest, and continued much beyond it dorsally; ventrally, the inferior pre-orbital ceases abruptly opposite the pupil or in front of this point. No trace of an infra-orbital. Distance from suprapectoral to lateral line 1.2 in its distance from base of ventrals (1.66 in *D. chrysorhynchus*). Fourth thoracic on level of base of ventrals, the third ventral only a trifle higher, much below the level of the supraventral, which is over the axil of the ventral and is nearer ventral base than lateral line. Third supra-anal immediately below lateral line, the three of the series in an oblique line, not angulated, the lowermost opposite the vent, above and behind the fifth ventral. First antero-anal elevated, not so high as middle supra-anal, in a line joining the upper supra-anal and second antero-anal. Second to fifth antero-anals form a slightly curved line which gently rises, the sixth more elevated. Postero-anals 5. Posterolateral but little below the lateral line, a trifle farther removed than the upper supra-anal. Precaudals forming a broad curve; the first two slightly less separated than the other two, the uppermost not so near the lateral line as the posterolateral.

Color very dark. A broad dark bar across mandibles below eyes; mouth and gill-cavity black.

Two cotypes from Sagami Bay, the largest 21 cm. (C. M. No. 4602). The type is deposited in the Carnegie Museum.

## 21. *Diaphus coeruleus* (Klunzinger).

*Scopelus coeruleus* Klunzinger, Verh. k. k. zool. bot. Ges. Wien., Vol. 21, 1871, p. 152. (Indian Ocean.)

*Diaphus watasei* Jordan and Starks, Bull. U. S. Fish Com. for 1902 [1904], p. 580. (Sagami Bay.)

*Scopelus engraulis* Günther, Deep Sea Fishes Challenger, 1887, p. 197, Pl. LI, fig. C. (Philippine Islands.)



Several specimens from Sagami Bay (C. M. No. 4603) were obtained from Mr. Alan Owston, and have been compared with the cotypes of *D. watasei* from the same locality. There seems no reason to doubt the identity of this material with *D. caeruleus* from the Indian Ocean. *D. engraulis* from the Philippines agrees in all respects except the smaller eye (said to be one-fifth the length of the head) but the figure shows it larger than this, and probably no difference exists.

22. *Diaphus latus* sp. nov. (Plate XIII, fig. 1.)

Type 75 mm. in total length, 64 mm. to base of caudal, from Sagami Bay; collection of Alan Owston (C. M. No. 4604).

Most nearly related to *D. splendidus*, *signatus*, and *sagamiensis*, but with deeper body, smaller eye, the pre-orbital restricted to the anterior border of the eye, the suprapectoral higher, the third supra-anal and the posterolateral in contact with the lateral line, the fourth precaudal immediately below it; the first antero-anal greatly elevated, nearly vertically above the second, the second to fifth antero-anals in a straight line, parallel with anal base.

Measurements in hundredths of length without caudal: Length of head 25; diameter of eye 5.5; length of snout 4; width over middle of orbit 7; length of maxillary 18; depth of body 23; of caudal peduncle 10; distance from tip of snout to dorsal 39; to base of ventrals 41; to front of anal 60; to adipose 76. Length of pectoral 11.5; of ventral 18.

Dorsal rays 15, including 3 rudiments, the posterior ray split to base; anal rays 16, including two rudiments; pectoral rays 12; ventral rays 9, the outer a short rudiment. Scales of lateral line 37, the upper supra-anal on the 18th scale, the posterolateral on the 26th or 27th. Gill-rakers long and slender, 7 + 15 (in cotype).

Body deeper than in related species; eye small, the profile rising well above its dorsal border; snout short, bluntly rounded; preopercular margin oblique, the maxillary reaching its margin. Pectoral short, not reaching base of ventrals, the latter not beyond the vent. Base of ventrals under or slightly behind the origin of dorsal; origin of anal slightly behind vertical from last dorsal ray, the last anal ray beneath the adipose.

Scales of lateral line not enlarged, their vertical diameter nowhere greater than their distance from mid-dorsal line.

*Photophores*.—Upper pre-orbital a small ocellated dot under the edge of the frontal, as in *D. signatus* and *D. agassizi*; lower pre-orbital occupying the area

between eye and nostril, expanding a little above the nostril, scarcely extending on the ventral aspect of the orbit; no trace of a suborbital. Suprapectoral immediately above angle of opercular flap, its distance from lateral line two-thirds its distance from base of upper pectoral ray (slightly lower in a cotype); the usual glandular body is attached to it below. None of the pectoral organs are concealed beneath the opercular flap. Fourth thoracic a trifle above the level of the ventral base, nearly vertically above the third thoracic. Supraventral nearer lateral line than base of ventrals. Third ventral not greatly elevated, a little below the oblique line joining first and second, not as high as the middle supra-anal. Supra-anals slightly angulated, the second a little in advance of the line joining the other two; the upper one is below the lateral line and in contact with it, the lower above and slightly behind the fifth ventral. First antero-anal greatly elevated, nearly vertically above the second, on a level with middle supra-anal, its distance from second much greater than that between second and third, and equaling that between third and fifth. Second to sixth antero-anals in a straight line, parallel with anal base, the seventh elevated, the line joining sixth and seventh passing just behind the posterolateral, which is in contact with the lateral line. Postero-anals 5. Last precaudal a little below the end of the lateral line, the first two horizontal, at lower edge of tail, the third a little above them.

General color very dark, the mouth and gill-cavity black; vertical fins with the rays black-dotted. The anal rays vary from 6 to 7 + 5 to 6.

Several cotypes from Sagami Bay (C. M. No. 4605). The type is deposited in the Carnegie Museum.

### 23. *Diaphus sagamiensis* sp. nov. (Plate XIII, fig. 2.)

Type 67 mm. in total length, 53 mm. to base of caudal, from Sagami Bay, Japan, collection of Alan Owston (C. M. No. 4608).

Most nearly related to *D. signatus* Gilbert, but with the lower pre-orbital extending along the ventral border of the orbit to vertical from posterior border of pupil, the supraventral photophore midway between lateral line and base of ventrals (decidedly nearer lateral line in *D. signatus*), the first antero-anal less elevated, the second much less widely spaced from third, and the precaudals less widely spaced, the fourth lower. The photophores are larger, and the form deeper. It differs also from *D. caeruleus* and *D. splendidus*, in the ventral continuation of the lower pre-orbital, and in details of position and spacing of the photophores.

Measurements in hundredths of length without the caudal fin: Length of head 28; diameter of eye 8; length of snout 4.5; length of maxillary 20; greatest depth of body 21; least depth of caudal peduncle 9; distance from tip of snout to front of dorsal 42; to insertion of ventrals 43; to front of anal 61; to adipose fin 75. Length of pectorals 11.5; of ventrals 16.

Dorsal rays 17 (including anterior rudiments); anal rays 15; pectoral rays 12; ventrals rays 9, the outer reduced to a short rudiment. Scales of lateral line 35, the upper supra-anal on the 18th scale, the posterolateral on the 25th. In a cotype, the upper supra-anal is on the 19th scale, the posterolateral on the 27th.

Snout very short, bluntly rounded, its length slightly exceeding half the diameter of the eye; pre-opercle only moderately oblique, the maxillary reaching its margin. Gill-rakers 8 + 17, more numerous than in *D. signatus*.

Pectorals short, not reaching ventrals, the ventrals not reaching beyond the vent, inserted under the front of dorsal. Last dorsal ray over or slightly behind origin of anal; last anal ray under the adipose. Scales all fallen. General color blackish; no dark bars evident on mandible.

*Photophores*.—Upper pre-orbital small, triangular, on the orbital margin, not constricted off from the broader mass of the lower pre-orbital, which fills the area on the dorsal side of the nostril, narrows between the nostril and the eye and continues without interruption on ventral side of orbit to or beyond vertical from posterior margin of pupil. Dorsally, the upper pre-orbital interposes between it and the eye, and mesially it is well separated from its fellow. It differs from the pre-orbital slightly in color and appearance, and does not in the lower part of its course give any evidence of union with a suborbital organ.

Suprapectoral high, its distance from lateral line but half its distance from pectoral base; attached to it a very small inconspicuous glandular organ. Fourth thoracic opposite to or very slightly above the base of ventrals. Supra-ventral midway between lateral line and base of ventral (in cotypes, a little nearer ventral). The line joining first and second ventrals passes above the third ventral, which is but little above the level of the base of the outer ventral ray. Supra-anals in a straight line, or the second slightly in advance, the first opposite the vent, above and behind the fifth ventral, the third in contact with the lateral line, vertically above the first anal ray. Antero-anals about equally spaced, the first much less elevated than in *D. signatus*, the line joining first and second passes below the upper supra-anal. All antero-anals except the first form a gently and regularly curved line rising posteriorly, the last sometimes a trifle

more elevated. Antero-anals normally 6 in number, the postero-anals 5; in one cotype the number is 7 + 4. Posterolateral immediately below lateral line, scarcely in contact with it. Precaudals in a gentle obliquely disposed curve, the first two more closely set than are the postero-anals, the last two a little more widely spaced; fourth precaudal well below end of lateral line.

Five cotypes from the same locality as the type (C. M. No. 4609), and one from Albatross Station 5064, Suruga Bay, taken with open intermediate net at 300 fathoms.

Type deposited in the Carnegie Museum.

### Genus *LAMPANYCTUS* Cocco.

#### KEY TO JAPANESE SPECIES OF *LAMPANYCTUS*.

- a. Luminous scales not confined to the precaudal region.
  - b. Dorsal and anal short, about equal in length. Only one photophore above the base of pectoral fin. Supra-anals in an oblique line.....*L. townsendi*.
  - bb. Dorsal and anal long, much overlapping, the dorsal the longest. Two pectoral photophores above the base of the pectoral fin. Supra-anals angulated. Two posterolaterals, on a level.....*L. japonicus*.
- aa. Luminous scales confined to precaudal patches, or with one in addition in front of adipose fin.
  - c. Supra-anals in an oblique line.....*L. leucopsarum*.
  - cc. Supra-anals angulated.
    - d. Pectorals short, not reaching base of ventrals.
      - e. Last precaudal vertically above the one preceding.....*L. niger*.
      - ee. Last precaudal above and behind the preceding.....*L. microchir*.
    - dd. Pectorals longer, extending well beyond base of ventrals.
      - f. A spot on the cheek and one on shoulder. Numerous accessory dots scattered over head and body.
        - g. Second and third antero-anals not elevated.....*L. punctatissimus*.
        - gg. Second and third antero-anals elevated, on the same level. *L. jordani*.
      - ff. A spot on the shoulder, none on the cheek.....*L. macropterus*.

#### 24. *Lampanyctus townsendi* Eigenmann and Eigenmann.

*Lampanyctus townsendi* Eigenmann and Eigenmann, West American Scientist, 1889, p. 125, from Cortez Banks, near San Diego, Cal. Gilbert, Mem. Mus. Comp. Zool., XXVI, 1908, p. 230, Pl. 4. (Marquesas Islands, Pacific Ocean.)

Three specimens, the largest 60 mm. long, taken off southern Japan. In life the species is almost jet-black, and probably lives at a considerable depth. One of the specimens was taken in a bottom trawl at 507 fathoms; the other two in an intermediate net operated at 850 fathoms. In both cases, they may of course have entered the net nearer the surface.



As previously indicated, this species is nearest *L. warmingi* Lütken, which has been reported from the Indian Ocean and the eastern part of the Atlantic. *L. townsendi* is readily distinguished from *L. warmingi* in the presence of 5 ventral photophores instead of 4. Also the fifth thoracic is elevated, on the level of the outer ventral rays, the supraventral is low, midway between lateral line and base of ventrals. In other respects, they seem very similar. The ventral photophores in *L. townsendi* are arranged much as in *L. maderensis*, the first pair closely approximated on the same level, which is about that of outer ventral ray, the fourth pair much more closely apposed, and the fifth pair again diverging at the sides of the vent and a little anterior to it. Additional points can be made out on these specimens concerning the distribution of the luminous scales. A short patch of five scales on back of caudal peduncle involves the rudimentary caudal rays; a long band covers all of inferior surface of caudal peduncle and contains twelve or thirteen scales; a series along each side of base of anal fin; a median series from base of ventrals to vent, and a pair at sides of vent; a median scale somewhat in advance of ventrals; a median scale on isthmus and two on each side forming with it lines diverging backwards towards bases of pectorals. As the skin is lost in front of the dorsal fin, no trace of luminous scales can there be found.

The figure of *L. townsendi* above cited, based on a very small specimen from the Marquesas Islands, represents the snout very much sharper than in the Japanese specimens, wherein it is rather heavy and bluntly rounded. No material is at hand for comparison.

#### LIST OF STATIONS.

4954. 32° 05' N., 133° 02' E. Intermediate net, 850 fathoms.  
4980. 34° 09' N., 137° 55' E. 507 fathoms.

#### 25. *Lampanyctus japonicus* (Tanaka).

*Macrostoma quercinum japonicum* Tanaka, Journ. Coll. Sci. Imp. Univ., 1908, p. 5, Pl. 1, fig. 3.

No additional material has been secured and the type has not been examined. Tanaka was unable to point out any differences between the Japanese species and *L. elongatus* (= *L. quercinus*) from the Atlantic, and the specific name is here retained awaiting an opportunity to make direct comparison of material from the two oceans. It is apparent that the number of photophores in Tanaka's figure is not entirely reliable. Apparently fragments of luminous

scales have been mistaken for photophores in some instances. Thus the lower of the pectoral series, two in the thoracic series and one of the supraventrals belong in this category and are redundant. If the number of gill-rakers is correctly given as  $9 + 13$ , this may serve to distinguish this species, as in several specimens of *L. elongatus* from the Atlantic, there are constantly eighteen to twenty rakers on the anterior portion of the outer arch.

26. *Lampanyctus nannochir* (Gilbert).

*Myctophum nannochir* Gilbert, Proc. U. S. Nat. Mus., XIII, p. 51; Pacific coast, U. S.

A single specimen was secured at Albatross Station 5030, in the southern part of the Okhotsk Sea, southeast of Cape Patience, Sagalin; hitherto unrecorded in the western Pacific south of Bering Sea. The specimen has all the characters which serve to distinguish this form from *L. leucopsarum*; the larger photophores, the smaller number of luminous scales on caudal peduncle, the somewhat lower position of the upper series of photophores on the sides, and the presence of three instead of four precaudals. Occasionally a specimen of *L. nannochir* has a fourth precaudal on one side, but no case has come under our notice in which *L. leucopsarum* has but three precaudals. In addition to these characters, it was ascertained during the cruise of 1906 that in life the photophores of *nannochir* are constantly a bright ruby-red, whereas in *leucopsarum* they are golden-yellow. No trace of this difference persists in preserved material. The two species are extremely closely related; occasionally a young specimen is difficult to determine. Furthermore, they accompany each other throughout their range. But a number of minor characters have thus far shown a constant correlation which makes it impossible to ignore them.

27. *Lampanyctus niger* (Günther).

*Nannobranchium nigrum* Günther, Deep Sea Fishes Challenger, 1887, p. 199, Pl. LII, fig. B.

A single specimen 71 mm. long, from Albatross Station 4958, in the Bungo Channel, depth 405 fathoms. The present status of the species is very unsatisfactory, as the original description and figure have no reliable indication of the distribution of the photophores. Our specimen is much slenderer than is indicated in the figure by Brauer (Die Tiefseefische, 1906, p. 242, fig. 159), agreeing in this respect and in general appearance with Günther's figure above cited. The position of the photophores agrees in most details with that shown by Brauer.

The suprapectoral is on the lateral line, the upper infrapectoral on a level with it and a trifle posterior. Fourth thoracic elevated, on level of middle of pectoral fin. Ventrals 4, the second a very little farther out at the side than the others, the fourth at sides of vent. Supraventral, third supra-anal, and posterolateral immediately below lateral line, the last precaudal on or above the lateral line. Supra-anals forming a very blunt angle, the third vertically above the first antero-anal, the second above the vent, the first just anterior to the third ventral; first and second on the same level, which is also that of the fourth thoracic. Antero-anals 7, their line not arched, the first two more widely spaced than the others, the last one elevated as usual. Postero-anals 8, continuous with the precaudals, the latter more widely spaced. Anterior 3 precaudals in a gentle curve at base of lower caudal lobe and evenly spaced, the fourth much more widely separated, above and slightly anterior to the third, on or a little above the lateral line.

The pectoral is injured, but was evidently short, and consisted of extremely delicate rays which are however more numerous than represented by Günther, being twelve or fourteen in number.

The color was black, the body is much slenderer than is represented by Brauer (l. c., p. 242, fig. 159), the depth a trifle less than one-fifth the length. The precaudals are also differently arranged, there being three instead of two along the base of the lower caudal lobe, and a fourth on lateral line, above and slightly anterior to the third. It may be that Brauer's figure is not entirely reliable, but the doubt he expresses concerning the identity of his specimens with Günther's species must also hold with the one here reported from Japan.

The three specimens previously reported from the Hawaiian Islands (Gilbert, Bull. U. S. Fish Com. for 1903 [1905], Part 2, p. 591) belong to this species. In the description, by error, four pectoral photophores are described, and the pectorals are said to contain but few (three to six) rays. A more careful examination shows the pectoral to contain about twelve excessively slender rays.

#### 28. *Lampanyctus microchir* sp. nov.

Type 22 mm. in total length, 18 mm. to base of caudal; from Albatross Station 5064, Suruga Bay, intermediate net at 300 fathoms.

Very closely allied to *L. macropterus* Brauer, differing in the following details in the arrangement of the photophores:

1. Suprapectoral on the lateral line, instead of a short distance below it.

2. Fourth thoracic slightly below level of pectoral, instead of above its level.

3. Second ventral above and somewhat anterior to the first, instead of above and behind it.

4. First supra-anal on level of second, over or before the fourth ventral.

ERRATA-

In *L. macropterus*, the first supra-anal is considerably below the level of the second, and behind the fourth ventral.

ERRATA-

Brauer compares *L. macropterus* with *L. oculus* Garman, with which species he at first identified it. But the two are not closely related. *L. oculus* has not only the infrapectorals obliquely arranged, but has both second and third ventrals elevated.

Measurements in hundredths of length without caudal: Length of head 33; diameter of eye 5.5; length of maxillary 23; greatest depth 21; least depth of caudal peduncle 6; distance from tip of snout to front of dorsal 53; to base of ventrals 46; to front of anal 56; to last dorsal ray 65; to last anal ray 75.

Dorsal rays 14; anal rays 17; pectoral rays 9; ventral rays 8. Scales of lateral line 34.

Ventrals inserted in advance of dorsal; origin of anal under middle of dorsal; pectorals very short and slender, not reaching ventrals; ventrals to vent.

*Photophores*.—A small pre-orbital on orbital margin immediately below level of posterior nostril; a small round spot on shoulder cannot be positively identified as a photophore; suprapectoral on the lateral line; upper infrapectoral in front of middle of pectoral base, the lower vertically below it. Thoracics five, the fourth elevated, vertically above the third and on level of lower pectoral ray; first thoracic interspace much wider than the others. Supraventral on the lateral line, somewhat in advance of the base on the ventral fins. Ventrals five, the second elevated, above and in advance of the first, the first, third, fourth and fifth equally spaced and equidistant from the midventral line. Supra-anals forming a right angle, the third on the lateral line under the middle of the dorsal fin, the second and first equally elevated, the second over or slightly in advance of the fourth ventral. Postero-anal on the lateral line. Antero-anals six, the fifth elevated, the others on the same level, the first interspace longer than those which follow. Posteroanals six, none of them opposite the anal fin. Precaudals three, the first above the first caudal ray, lower than the last postero-anal and separated from it by a wider space than occurs between the postero-anals; second precaudal elevated, a little behind the oblique line joining first and third, its distance from first little more than half its distance from the third, which is above and a little behind it, in contact with the lateral line.



Luminous scales confined to the caudal peduncle, three on the dorsal side, four ventrally. No minute accessory photophores.

Only the type known; deposited in the U. S. National Museum.

29. *Lampanyctus punctatissimus* sp. nov.

Type 20 mm. long to base of caudal fin, which is mutilated, so the total length cannot be ascertained. Albatross Station 5064, Suruga Bay, Japan, intermediate net at 300 fathoms.

Closely allied to *L. alatus*, differing in the presence of a spot on shoulder and a luminous scale before the adipose, and in the shorter pectoral fin.

Measurements in hundredths of length without caudal fin: Length of head 32; diameter of eye 5; length of snout 5; length of maxillary 24; depth of body 20; least depth of caudal peduncle 7; distance from tip of snout to front of dorsal 48; to front of ventrals 46; to front of anal 60; to last dorsal ray 62.

Dorsal rays 12; anal rays 17; pectoral rays 12; ventral rays 8. Scales of lateral line 34.

Snout short, but not rounded; a depression over front of eyes; middle of maxillary under posterior border of eye.

Origin of dorsal behind base of ventrals, its last ray about over the fifth of the anal. Pectoral more or less mutilated in all our specimens, but apparently not extending much if any beyond the front of the anal.

*Photophores*.—A well-developed spot on middle of cheek and one somewhat smaller on the shoulder. Suprapectoral very near the lateral line; upper infrapectoral somewhat above the middle of the pectoral base, the lower infrapectoral below and behind it in a line joining the upper infrapectoral and the second thoracic. Thoracics five, the fourth elevated, over the space between the third and fifth, on a level with middle of pectoral base. The second thoracics are about midway between the first and fifth pairs, the third nearer the second than the fifth. The second and third pairs are but little farther from mid-ventral line than the first pair, but the fifth are out at the sides in front of the outer ventral rays. The supraventral, upper supra-anal, posterolateral and upper precaudal are equally elevated and are near the lateral line but not in contact with it. Ventrals four, none of them elevated. Supra-anals forming a right angle, the anterior somewhat more elevated than the middle one, over the interspace between the second and third ventrals. Antero-anals seven, the posterior elevated, the first six on the same level. Postero-anals continuous with the precaudals, but a slight widening of the spacing seems to indicate that the precaudals are four in

number, the postero-anals six. The first two precaudals are in line with the postero-anals, the third a little elevated, the fourth near the lateral line, above and slightly in advance of the third.

Three luminous scales in front of lower caudal lobe, two in front of the upper; a single luminous scale in front of adipose fin.

In addition to the larger photophores, the head and body are thickly set with smaller luminous dots, which are surrounded with black pigment-rings and show a more or less definite arrangement. A well-defined series of about fifteen occur equally spaced along outer surface of mandible, and a similar series is on the maxillary. On sides of head and body, there is one to each scale, arranged under the tip of the exposed portion, as in *L. jordani*. A few extend out on the base of the caudal fin.

The general color is blackish brown.

The type is deposited in the U. S. National Museum.

#### LIST OF STATIONS.

4969.	33° 23' 40" N., 135° 33' E.	Intermediate 300 fathoms.
5058.	Suruga Bay	Intermediate 300 fathoms.
5064.	Suruga Bay	Intermediate 300 fathoms.

#### 30. *Lampanyctus jordani* sp. nov. (Plate XIV.)

Type 121 mm. long to base of caudal, from Nemuro, Hokkaido, Japan (C. M. No. 4617), obtained in 1900 by Dr. Jordan.

Most closely related of *L. macropterus* Brauer, but the second and third antero-anals equally elevated, well above the level of the remainder of the series. A spot on the shoulder and one on the cheek. Four ventral photophores, none of them distinctly elevated. Luminous scales confined to the caudal peduncle and the front of the adipose fin. Dorsal fin shorter than the anal.

Measurements in hundredths of length without caudal fin: Length of head 27 (in cotypes 28); diameter of eye 6; length of snout 4.5; frontal width opposite middle of orbit 8; length of maxillary 20; depth of body 23; depth of caudal peduncle 12; distance from tip of snout to origin of dorsal 47; to base of ventrals 44; to last dorsal ray 60; to first anal ray 59; to last anal ray 80; to front of adipose dorsal 81; length of pectoral 23; of ventral 16.

Dorsal rays 13 (including 2 rudiments); anal rays 18 (2 rudiments); pectoral rays 15; ventral rays 9 (outer ray rudimentary). Scales of lateral line 40.

Mandible strongly upcurved towards symphysis, protruding beyond the

premaxillaries, reaching far beyond the eye. Dorsal origin distinctly behind insertion of ventrals, in advance of the middle of the body. Last ray of dorsal opposite or slightly behind the first of the anal. Last anal ray under the adipose dorsal. Pectorals long, reaching in the cotypes to or nearly to the vent; ventrals reaching front of anal.

*Photophores*.—Reniform in shape in uninjured specimens, those of the upper series most strongly marked in this respect. A minute pre-orbital slightly below the line joining the eye and nostril. One on cheek, in contact with upper border of maxillary. A small distinct spot constantly present on the shoulder, and another not represented in any other species, above and slightly behind the base of upper pectoral ray. Suprapectoral near lateral line, but distinctly below it. Upper infrapectoral in front of pectoral base above its middle, the lower infrapectoral below and behind it. Thoracics five, the fourth much elevated, on level of base of pectoral, the first pair nearer the median line than the second and third, the fourth farther apart on level of outer ventral ray. Distance between the first and second pairs greater than between the second and third, or between the third and fifth. Supraventral, upper supra-anal, posterolateral, and upper precaudal immediately beneath the tubes of the lateral line. Ventrals four, the first pair opposite the inner ventral rays, the second farther out at the side, but not distinctly elevated, on level of outer ventral rays, the third and fourth forming with the second a straight line, which slightly approaches the midventral line posteriorly. The four pairs are about equally spaced. First and second supra-anals on the same level, the first over the second ventral, the second over the fourth ventral. Antero-anals eight, the second and third elevated, on the same level, the eighth also elevated, slightly nearer the seventh than the posterolateral. Postero-anals eight or nine. Precaudals four, the lower three in a curved line at base of lower caudal lobe, the fourth more widely separated, on the lateral line. In the type, the first precaudal is a trifle lower than the last postero-anal and less definitely set off from that series than in the cotypes, where it is not only lower, but more widely spaced.

In addition to these larger photophores, there are numerous minute luminous dots on sides of head and on body, one of these on each scale of trunk, at the tip of its exposed portion.

Luminous scales: two in front of upper and nine in front of lower caudal lobe; two or three, with occasional traces of one or two more, in front of adipose fin.

General color dark brown or blackish, the fins a little lighter. The type is an old specimen bleached in the light. It was much darker in life than the figure indicates.

Two cotypes were secured at Albatross Station 5039, off the southern shore of Hokkaido ( $42^{\circ} 11' N.$ ,  $141^{\circ} 57' E.$ ); depth at bottom 269 to 326 fathoms. Type deposited in the Carnegie Museum.

Named for David Starr Jordan in appreciation of his epoch-making researches on the fish-fauna of Japan.

### 31. *Lampanyctus macropterus* (Brauer).

*Myctophum* (*Lampanyctus*) *macropterus* Brauer, Zoöl. Anz., 1904, p. 404, fig. 5; Indian Ocean.

A single specimen, 105 mm. long, was secured by the Albatross at Station 4951, near Kagoshima ( $31^{\circ} 10' 30'' N.$ ,  $131^{\circ} 58' 30'' E.$ ). The dredge was sent down in 703 fathoms, but evidently failed to reach the bottom as the contents were all deep pelagic, the failure obviously due to the swift currents of the Kurosiwo.

The specimen is larger than any of Brauer's types from the Indian Ocean, and differs from his description and figure in the following respects:

1. Only the first of the postero-anal photophores lies over the base of the anal fin.

2. The second of the ventral series is less elevated and more obliquely placed with reference to the first ventral. It is distinctly below the line joining the first and second supra-anals.

3. Second and third antero-anals nearly equally elevated, though less so than in *L. jordani*, both well above the level of the first, fourth, and fifth antero-anals. Sixth antero-anal elevated, nearly midway between the fifth and the posterolateral.

4. The luminous scales completely cover the lower margin of caudal peduncle and are eight in number.

No spot on check, none above and behind upper pectoral ray, no accessory spots on head or body, and no luminous scales before the adipose; differing in these respects from *L. jordani*.

Humeral spot unusually large, nearly equal in size to the spots on body. Upper infrapectoral on level with upper pectoral rays. First supra-anal much lower than the second, the line joining the two reaching lower profile in advance of third thoracic, passing well above the second ventral. Anals six to nine. Distinctly four precaudals, the first and second dropped below the line of the postero-anals, and separated from them by a slightly wider interspace. The third is more elevated than in *L. jordani*, but is nearer the second than the fourth.

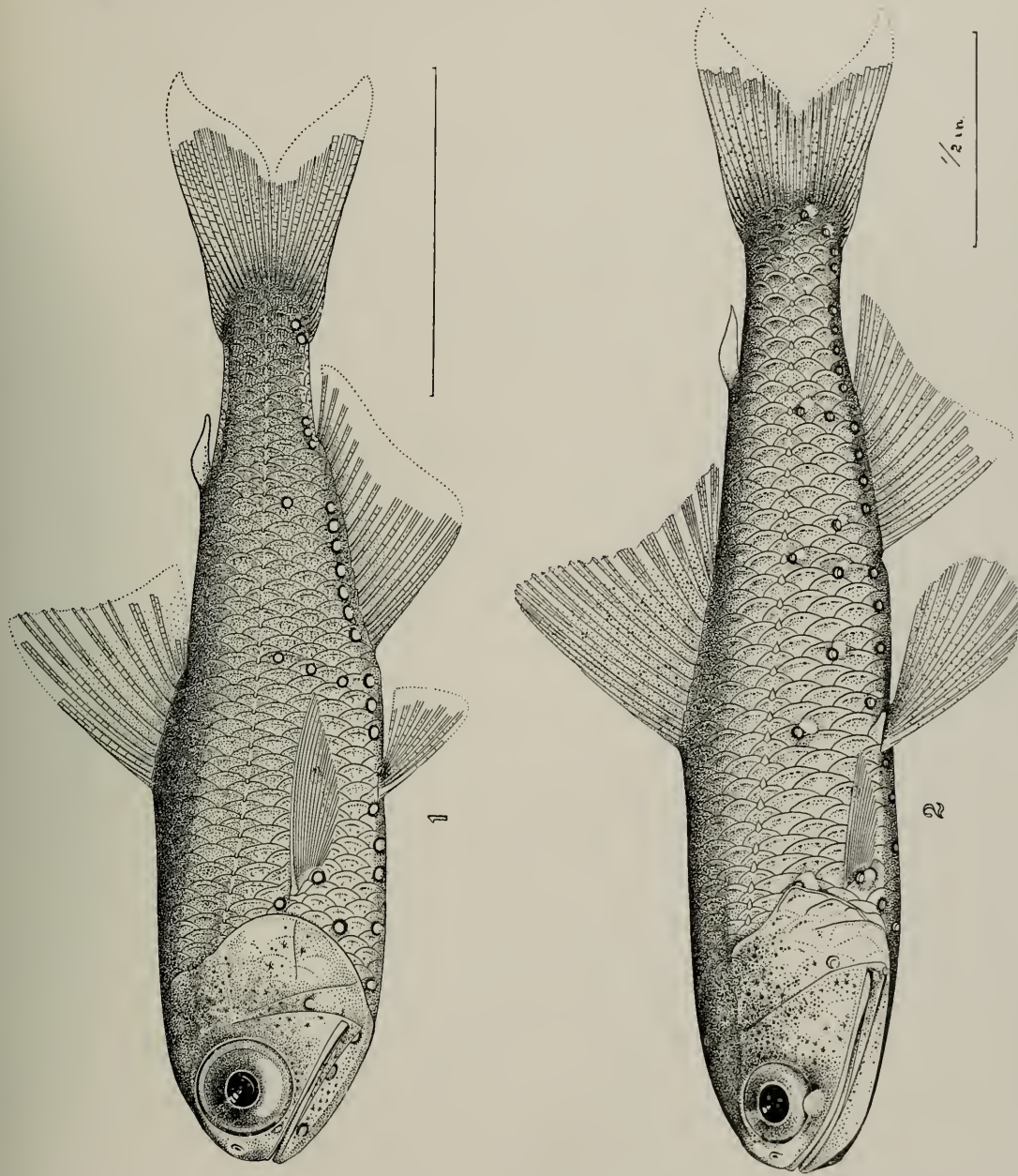


The upper supra-anal, the posterolateral, and the upper precaudal are in contact with the lateral line, but the supraventral is lower, its distance from lateral line one-half its distance from base of ventrals.

Origin of anal under middle of dorsal or slightly behind that point. Pectorals reaching middle of anal base.

The extent to which these forms vary within the species is still to be determined, so I have not recognized as of specific value the peculiarities of the Japanese specimen here described. One of the specimens figured by Brauer (*l. c.*, fig. 167) varies in so many details from the type, that it may well represent a different species. Unfortunately, Brauer fails to designate any single specimen as his type, and totally neglects to give data for his figures.



FIG. 1. *Dasy Scopelus orientalis* GILBERT. Type. Sagami Bay, Japan. C. M. No. 4613.FIG. 2. *Diaphus glandulifer* GILBERT. Type. Albatross Station 5058, Suruga Bay, 300 fathoms.





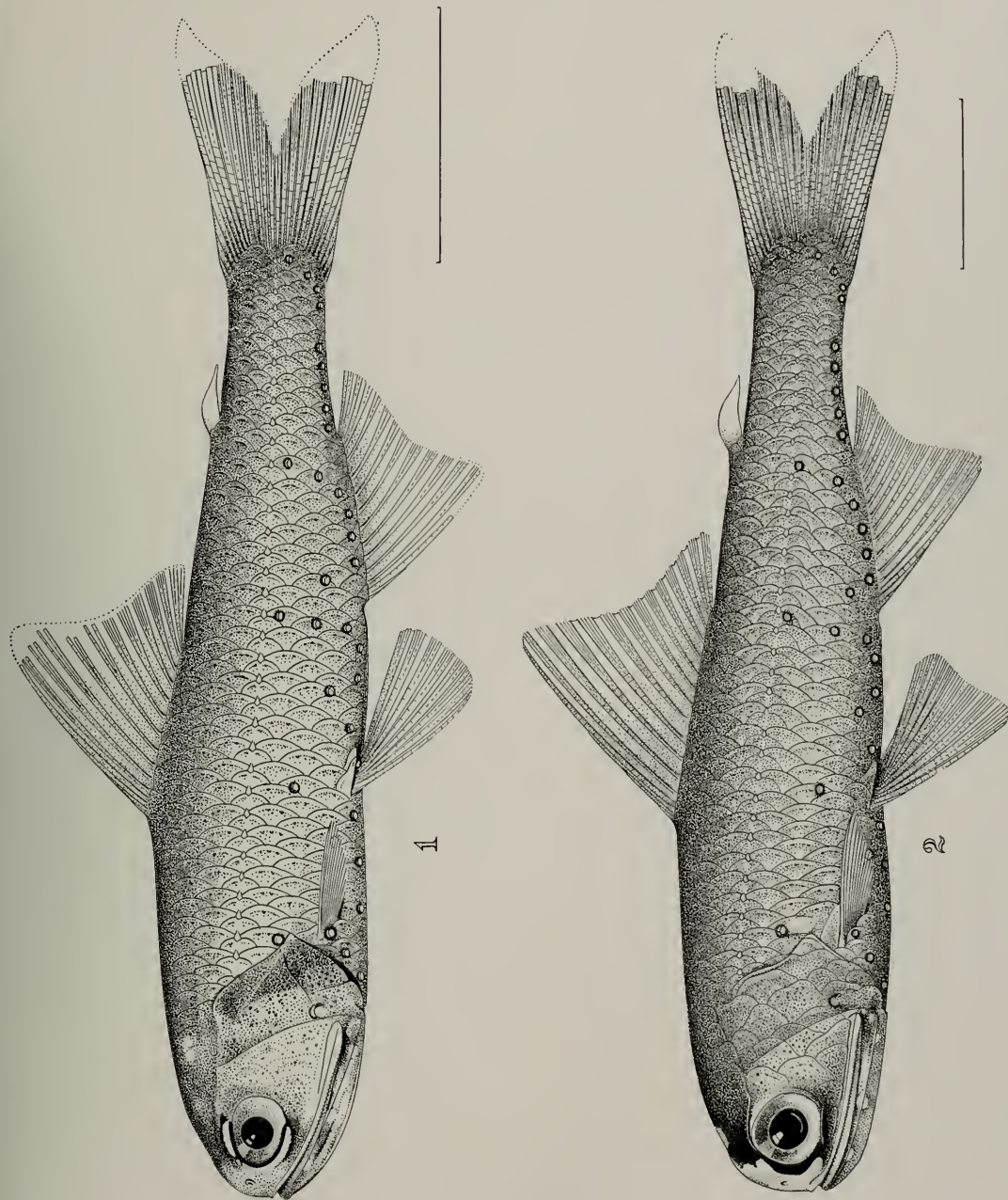


FIG. 1. *Diaphus anteorbitalis* GILBERT. Type. Albatross Station 4908, Southern Japan, 253 fathoms.  
FIG. 2. *Diaphus gigas* GILBERT. Type. Sagami Bay, Japan. C. M. No. 4601.



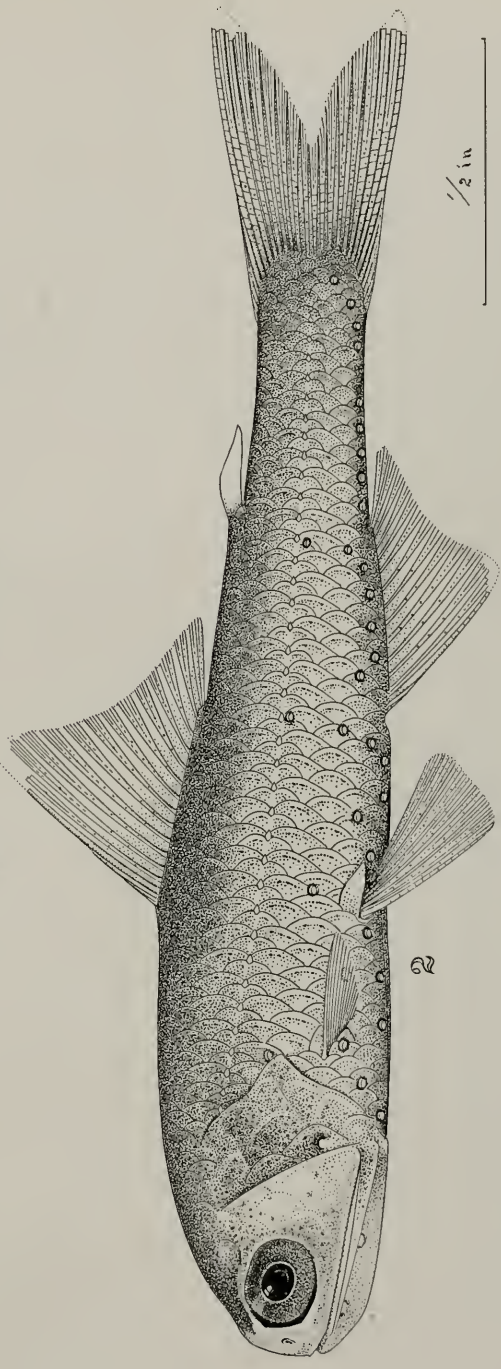
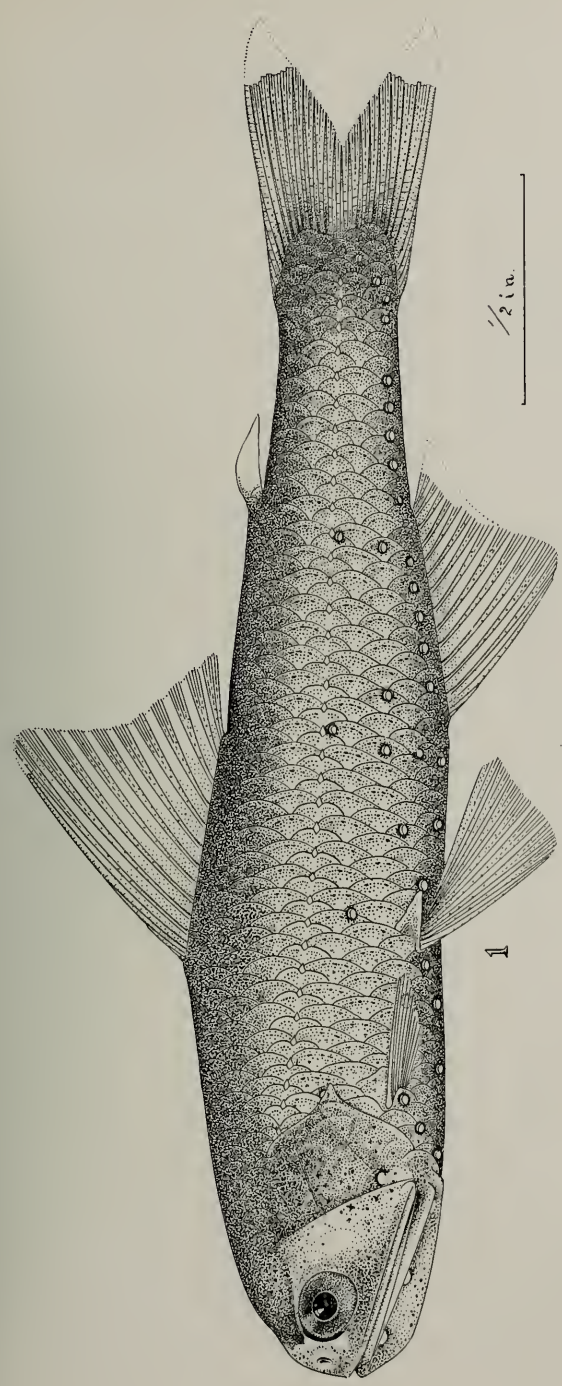
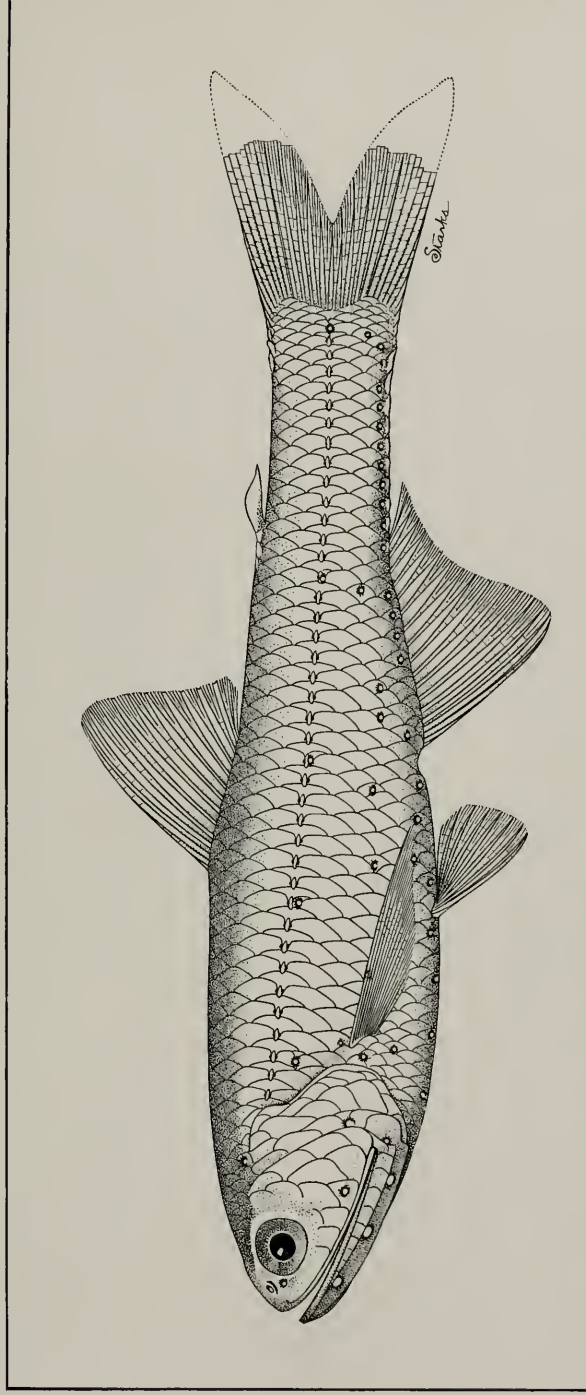


FIG. 1. *Diaphus latus* GILBERT. Type. Sagami Bay, Japan. C. M. No. 4604.  
FIG. 2. *Diaphus sagamiensis* GILBERT. Type. Sagami Bay, Japan. C. M. No. 4608.







*Lampanyctus jordani* GILBERT. Type. Nemuro, Hokkaido, Japan. C. M. No. 4617.

